METHODS AND MATERIALS ON THE MEASUREMENT OF INDUSTRIAL PRODUCTIVITY

ORR 103-51

ANNEX "A"

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This folder contains abstracts from some of the principal foreign, non-Soviet reports and studies dealing with the subject of industrial productivity. This material was drawn upon in the preparation of ORR project 103-51 but was not intended to be a part of that report and consequently is available only in the form of this single file copy.

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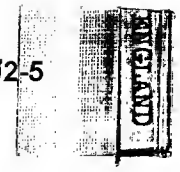

A survey of the material published in England on international comparisons of productivity indicated the major sources of information to be a number of articles published in several periodicals, two monographs prepared under the auspices of the National Institute of Economic and Social Research, and the reports of the Anglo-American Council on Productivity.

The November 1933 issue of the Quarterly Journal of Economics contained an article by Sir Alfred Flux entitled, "Industrial Productivity In Great Britain and the United States." Almost ten years later in April of 1943, Laszlo Rostas published an article in the Economic Journal entitled, "Industrial Production, Productivity, and Distribution in Britain, Germany, and the United States." This particular article formed the basis of the presidential address delivered by Dr. Ernest Snow when he assumed the leadership of the Royal Statistical Society in March 1944. This address, "The Internation Comparison of Industrial Output," was published in that Society's Journal in 1944. In the July 1946 issue of the Bulletin of the Oxford University Institute of Statistics, Mr. T. Barna published his paper, "The Productivity of Labour: Its Concepts and Measurement." Mr. Rostas also wrote two monographs in 1948 under the sponsorship of the National Institute of Economic and Social Research under the titles, Comparative Productivity In British and American Industry and Productivity Prices, and Distribution In Selected British Industries. A review of these articles will indicate the various concepts of international productivity comparisons as considered by English authorities and will add to the conclusions and recommendations of the more recent studies made

by teams of the Anglo-American Council on Productivity.

I. Sir Alfred Flux expressed the purpose of his paper in the following words:

> "The fact that there has been established in Great Britain a system of periodic measurement of output in manufacturing establishments the governing principles which are, in the main, similar to those applied in the United States Census of Manufactures, tempts the student of the reports issued on the two sides of the Atlantic to inquire what can be learned from a comparison of the particulars published."

He admitted that there were certain difficulties in comparing the material - the years to which the American data applied were not the same as those selected for the British data; the scope of the two inquiries did not appear to be the same in all respects; the American census lacked particulars in regard to the number of females employed and therefore "comparisons must be made with some hesitation where efficiency or earnings are concerned;" the collection of wages figures in the United Kingdom were the result of voluntary inquiry and could vary "in their respective character from industry to industry;" the treatment of "money totals for different trades" was made difficult by the "fluctuation in the rate of exchange between dollars and pounds;" the structure of industry in the two countries was different. Even though recognizing that there were serious omissions

in the data, Sir Alfred Flux stated that the available statistical material left a "sufficient and sufficiently distributed mass of industrial operations to anticipate that the averages that are calculated will have a representative character."

Four statistical tables were included in this article giving employment, wage, net output, and mechanical horsepower figures for 1924 in the U. K. and 1925 in the U. S. Indices of net output per person employed in specified trade groups also were computed for these years using 1907 (U. K.) and 1909 (U. S.) as the base years.

On the basis of these tables Flux maintained:

> "Not only was the total of persons employed greater in the United States in the proportion of about 17¼ to 10 than in the United Kingdom, corresponding to the even larger contrast in population in the two countries, but the average wages in the United States exceeded the average in the United Kingdom in the proportion of nearly 25 to 10 and the average net output was greater in the proportion of about 28 to 10. The fundamental contrast is not accidental, not consequent on the existence of a special class of product here and there, but the expression of a real general difference in the magnitudes compared . . . Taken as a whole, the illustrations selected. . . provide little reason for assigning to differences in price levels in the United States and in the United Kingdom the somewhat striking contrasts in wages per operative and in net output per person employed."

In summation Sir Alfred Flux reiterated the difficulties in making comparisons of productivity, but concluded:

> "It appears impossible, however, to escape the evidence of a larger physical output, per person employed, in the United States than in Great Britain, an output more than

> double as great in the former country as in the latter. Of marked variation, or secular increase, in this proportion, the evidence is not conclusive."

II. In his first article written in 1943, Dr. Rostas declared that the purpose of his paper was "to show how the scope of manufacturing production, the scale and composition of the labour force, the relative importance of different industry groups, the ratio of profits to wages and industrial efficiency as measured by output per head, compares with one another in these three countries [Britain, Germany, and the United States]."

The statistical information presented included the summary results of the Censuses of Production in the United Kingdom, Germany and the United States; employment in manufacturing production; the scale of manufacturing production; the structure of manufacturing production; physical output per head in certain manufacturing industries and mining; the value of net output per head of operatives; long term changes in productivity, in manufacturing industry; composition of labour force in manufacturing industry; and the share of wages in the value of net output.

The German data, taken from varied sources, related to 1936; the British data taken from the Census of Production related to 1935; and the American data taken from the Censuses of Manufactures related to 1935 and 1937. With reference to the dates selected the author pointed out that

in Germany rearmament was much greater in the manufacturing industry in 1936 than in the two other countries in 1935 or 1937: that in the comparisons British data was somewhat unfavourable because of the necessity of using 1935 figures; that the data for 1937 in the United States was more representative for purposes of comparison since in 1935 "American industry was still in a state of depression as compared with the German and British industry."

The Scale of Manufacturing Production tables showed "the preponderance of manufacturing industry in Britain . . . by the fact that these figures [labour force employed in manufacturing industry] represent one-fourth of the total occupied population of Britain and only one-fifth of the occupied population of Germany and the United States." Rostas also found that :

> "The proportion of occupied population to total population is slightly higher in Germany than in this country [Britain], but a greater proportion is in agriculture and handicraft. In America the proportion of those gainfully occupied is lower than in both other countries, and the number of those occupied in agriculture is relatively high. The proportion of those occupied in services is about the same in Britain and the United States, but it is lower in Germany."

In comparing the "aggregate net output" of the manufacturing industry in these three countries, Rostas took $4.90 - 4.94 to the £ and Rm. 17.08 to the £ as the "appropriate rate

of exchange" for measuring relative purchasing power in 1935-7 and concluded that :

> "If the output of Britain in 1935 is taken as 100, German output in 1936 was 127, the United States output was 320 in 1935 and 430 in 1937. Since the German output exceeded the British output in about the same ratio as German industrial employment exceeded the British, it follows that productivity (i.e. output per head) of British and German industries was roughly the same, while the productivity of the United States was about twice as large."

As far as the structure of manufacturing production in the three countries was concerned, Rostas stated that "the proportionate importance of the different branches of manufacturing in aggregate output produced and in total employment is fairly similar in all three countries."

The productivity per head in the different countries was compared on the basis of physical output per head and on the value of output per head. Dr. Rostas found that there was considerable difficulties involved in comparisons of physical output per head due to the fact that "individual industries, as classified by the censuses, each produce a group of products and by-products which are not identical in the different countries, either as regards type or quality or relative importance of individual types within the group." Therefore, he could compare only "a certain number of industries for which quantitative date were available, and the output could be reduced to homogeneity." It was discovered that the physical output per head comparisons largely confirmed the results of output per head on the basis of value of output, that

"industrial

efficiency - as measured in production per head - was roughly similar in Great Britain and Germany, while in the United States it was more than twice as great as in the two other countries." Rostas added that this conclusion did not take into account the "wide differences of weekly man-hours; on an output per man-hour basis, the superiority of the United States would be even greater."

A footnote to the table of physical output per head comparisons called attention to the fact that the index numbers "should be regarded as merely in the nature of rough approximations." Dr. Rostas outlined the method he used to arrive at his output figures:

> "The method followed was that of computing quantitative data of the production of comparable commodities (or group of commodities), and discovering the number of operatives producing the respective quantities. Where the trade to be compared produced more than one commodity . . . or different types of the same commoditiy . . ., they were converted into one homogeneous product, either on the basis of physical weights . . . or on the basis of their relative values . . . For obvious reasons, there was no allowance for qualitative difference. . . In order to arrive at the number of operatives employed in producing the volume of output compared, it was necessary to exclude operatives producing by-products not included in the comparison or those doing repair work, etc. In many cases this was possible only by assuming that the net output per head within the same industry was the same irrespective of whether the operative was engaged in producing the main product, or the by-product, or was engaged in doing repair work. It is obvious, therefore, that

> much arbitrariness was envolved in these calculations in almost every single case and some of the indices . . . are highly conjectural."

Dr. Rostas also added a footnote to his calculation of value of net output per head:

> "Rates of conversion used were $4.94 to the £ and Rm. 17.08 to the £ . It must be emphasized that the conversion rates were chosen to correspond to relative purchasing power in terms of commodities in general, and not (or not necessarily) in terms of the products of the individual industrial groups. To the extent the purchasing power parity in terms of these individual groups would yield different results, the figures in the above table must be considered arbitrary."

This paper also contained a discussion of the efficiency of labour and the variations of the values of output per head in the individual industries in the three countries.

In discussing the long-term changes in productivity in the three countries, it was determined that the long-term trend (measured by relating indices of physical production to indices of employment in the period 1929-1939) showed "the greatest increase in Britain, a much smaller though steady increase in Germany, while it was stationary (until 1939) in the United States."

The analysis of the composition of the labour force in the United States, United Kingdom, and Germany showed that the relationship of administrative, clerical, and technical staff

to the operatives employed was fairly similar in all countries and that female labor had greater importance in the manufacturing production of Britain than in Germany but was of least importance in the United States.

As far as the distribution of income in manufacturing was concerned, Dr. Rostas found that, if the "ratio of wages in the value of net output" were selected as the "most representative single index relating to the distribution of income in manufacturing," this ratio was "much lower in Germany than in the two other countries," and that it was highest in the United Kingdom." On a long-term basis, however, there was a "decline in the share of wages in Britain, a sharp fall in Germany at the bottom of the depression, where it was maintained at this low level ever since," and a "rising tendency in the United States since 1933."

Dr. Rostas made a brief comparison of productivity in agriculture in the United States, United Kingdom, and Germany. By relating employment data to output data, he calculated that "physical output per head does not differ substantially between the U. S. and U. K. (although it might be slightly higher in the U. S.) while in Germany it is perhaps half as high as either in the U. K. or in the U. S."

III. The findings of Dr. Rostas mentioned above were critically evaluated by Dr. E. C. Snow in his presidential

address to the Royal Statistical Society. Dr. Snow confined himself to the U. S. - U. K. comparisons and had seven major points of criticism.

1. The importance of periods used for comparison.

   It was felt that using data for the two countries which referred to data separated by an interval of as much as two years could be a "source of appreciable error," and that this procedure showed the United Kingdom "in a more unfavourable light than would otherwise be the case."

2. Conversion of different types into one product.

   Dr. Snow believed that to convert output into "one homogeneous product" the system of weighting the output of the various types should be some measure of the labour envolved (e.g. wages) in making each type. He criticized Dr. Rostas's method which he described as based on "relative values" - that is to say, the output of each type was multiplied by the average gross value of that type."

3. Determination of number of workpeople associated with a particular physical output. The difficulty of determining the "correct number of 'heads' applicable to the actual quantity" receives emphasis along with the assertion that "no satisfactory comparison of productivity of labour in the two countries can be obtained in the absence of information re-

the belief that short time working was less prevalent in the United States than in Britain and, if this factor were considered in the productivity calculations, British "output per operative" would be increased.

4. Difficulty of industrial grouping. It was felt that a point indicating lack of comparability in measuring physical output per head arose from the fact that "firms not within the industry have some production of the chief products of the industry;" and "the employees in these firms are counted with the industry of their main products, but some of the products (of minor importance to the firms concerned.) may be counted in the output of another industry..."
Dr. Snow stated that an "essential feature for proper comparability of 'physical output per head' for a certain article in two countries is that the figures of the operatives should relate exactly to the production of the article and nothing else . . ."
He suggested that a "partial explanation of the very unfavourable showing of the United Kingdom in motor-car production per head is due to this difficulty of the proper determination of the number of 'heads'."

5. Physical output per head for areas in the same country. Dr. Snow thought it would be of interest, in attempting to evaluate comparisons of productivity indices of a same

method in determining the physical output per head for a particular industry for different areas of the same country. In taking the footwear industry in England as an example, he found differences in the productivity indices of the areas considered - one being as high as 67 per cent above that of another. He felt that the figures reflected the "peculiarities of statistics rather than factors within the industry" and stated that the fallacy lay in assuming that "for the purpose of measuring physical output the various types of footwear can be weighted 'on the basis of their relative values'. . ."

6. Need for specialist knowledge of industries investigated. It was suggested that it would be very useful to have the indices of output provided by Dr. Rostas examined by specialists of the industries concerned. Dr. Snow added that until these specialists were in a position "to throw light on the subject" the profitability of discussing the problem of comparing productivity indices in general terms was doubtful.

7. Interpretation of census of production results. Dr. Snow enumerated eleven difficulties envolved in the interpretation of this material.

(1.) Value of gross output was determined differently in the two countries.

(2.) The figure for value of gross output in both countries was misleading as it contained "a good deal of duplication."

(3.) In comparing the values for both countries and converting these values into a common currency, some assumption had to be made in regard to the appropriate rate of exchange. Dr. Snow felt that there was no "logical justification for taking the average market rate for the year."

(4.) The value of cost of materials used appeared to be determined differently in the two countries.

(5.) The scope of the two censuses differed with regard to their definitions of a "small firm." The United Kingdom definition excluded about 8 per cent of the total output of the country while the United States definition appeared to exclude less than ½ per cent.

(6.) There appeared to be a difference in the practice regarding the item "work done on commission or contract work" in the two censuses. The value of goods produced "on contract for firms who are not themselves manufacturers" was excluded from the British data.

(7.) In spite of the fact that the census was to relate to the output of the year 1935, the United Kingdom "firm figures for 'financial years' ending at any time between April 7th, 1935 and April 8th, 1936 were accepted."

(8.) The classification of industries and of "establishments into industrial groups" differed in the two countries and comparisons of figures for industrial groups having similar descriptive titles could thereby be substantially affected.

(9.) The calculation of the number of workpeople, in an industry differed in the two countries as the United Kingdom included "employees engaged upon the delivery and transport of goods where those operations are carried out by the employees of the manufacturing firms."

(10.) The reports did not indicate the time the employees were occupied and "the practice regarding short time in the two countries" was not the same.

(11.) The possibility that "inaccuracies in the individual returns may have greater affect in the

aggregate in one case than in the other should not be overlooked."

On the basis of the above mentioned criticisms, Dr. Snow concluded:

> "The examination I have made of the data of the two countries has led me to the conclusion that they do not afford a reliable means for comparing industrial productivity per head in the two countries."

A general discussion followed Dr. Snow's address. A brief summary of some of the points mentioned will reflect the different attitudes towards this criticism of Dr. Rostas's paper.

Mr. Leak disagreed with Dr. Snow's suggestion that the correct method of adding dissimilar things was to weight the output of different types by factors representing the labor involved in their production - organization and machinery were most important. He felt that "duplication in gross output is a most fruitful source of error as affecting comparability of statistics," but added that the differences between the two censuses of production years did not have "any significance for industry as a whole." It was also his belief that short time or over time was not significant when comparing output per operative in Britain and the United States. In conclusion he stated that Britain should "strive to improve [her] physical output per head by increased mechanization," but that the "all-important question of quality" should not be overlooked.

Mr. Henry Clay felt that Dr. Snow's views in regard to the two Censuses of Production did not mean that a study of the two censuses was irrelevant to a study of the Comparative Productivity of the two countries.

Mr. Geoffrey Crowther said that the "most obvious and general evidence [of higher U. S. productivity], namely, the national income of the two countries" was an important consideration for when "allowance has been made for the larger proportion of agricultural population in the United States, it was quite impossible to understand the comparison between the incomes of the two countries, at any reasonable rate of exchange, without assuming that productivity in the United States was very much larger than in this country." On the subject of quality, he stated that British goods were not better than American.

Mr. Roy Glenday doubted whether international comparisons of output per head served much useful purpose unless accompanied by detailed information about the environment of the industries that were being compared.

Mr. T. Barna suggested that "more light could be thrown on the problem of quality if the approach is made through comparing prices instead of quantities." He added that such a comparisor should be made in markets where British and American goods compete, perhaps in a third country.

Mr. Maizels and Mr. Friday accepted the conclusion of greater

productivity per head in the United States and suggested that attention be given to factors underlying the differences with Britain.

Dr. Rostas replied to this criticism of his article, "Industrial Production, Productivity, and Distribution in Britain, Germany, and the United States" and emphasized the following points:

(1.) Periods used for comparison. Dr. Rostas said, "As Dr. Snow himself emphasizes, comparisons of physical productivity must take into account the degree of utilization of capacity of manpower and (I would add) of equipment, because output per head varies with the degree of unemployment and excess capacity. Now 1935 was a year of depression in the United States to a far greater extent than in England." Therefore, he felt that comparing 1937 in the U. S. with 1935 in the U. K. afforded a "much truer basis of comparison than having 1935 in both countries." Dr. Rostas felt that Dr. Snow's comment on the use of figures for "financial years" was an extremely small point.

(2.) Conversion of different types into one product. The method used by Dr. Snow of using the labour (e.g. wages) involved as a weight in converting the different products of the same industry into one homogeneous product was thought to be "theoretically" incorrect. Rostas believed the "theoretically correct method would be to use relative wage costs plus gross

margins or (taking the nearest Census concept) relative net outputs of different types as weights, using, moreover, identical weights for both countries, based on their relative net values and, if the results of the two sets differ, to take the difference between them." He also added that "Dr. Snow's argument that because with my method there would appear differences in productivity between areas in Britain, this proves that my method is unsatisfactory can hardly be accepted." Dr. Rostas reasoned that in "comparing British and American footwear grades, the internal structure of the trades is similar, . . . the arbitrariness of the method is minimized;" but that in "comparing different districts of Britain, you find . . . that one district . . . produces almost exclusively men's wear, other districts . . . almost exclusively women's and children's shoes, . . . any arbitrariness which might be involved in the gross weighting method is maximized in the geographical comparisons, . ."

(3.) Determination of number of workpeople associated

with particular physical output. Dr. Rostas stated that there was no difference between him and Dr. Snow "that in taking any one product, the same manufacturing processes should be compared, and only those operatives taken into account who are engaged in the manufacturing process of the chosen product." He continued, "As I indicate the method I follow and even its limitations, I am surprised to read [the] paragraph in Dr. Snow's paper, which implies that I relate to a varying percentage of gross value always 100 per cent of operatives." Dr. Snow's observation "that a part of the output might be produced by other trades, which is included in the output, but may not appear in the number operatives," was declared to be "automatically corrected" by Rostas' calculations. Dr. Rostas replied to Dr. Snow's observation in regard to the difficulties of the differences of industrial classification in the following manner:

> "Owing to differences of classification, it happens that some trades are separate groups in the U. S. . . while in Britain they are . . . sub-groups of one bigger group. This means that certain data (e.g. number of operatives or wages, but not data on net output as Dr. Snow incorrectly states) are available only

> for the whole group, but not for the sub-group. . . As the total number of employees for the sub-groups is given and the ratio of operatives to total employees in the group is known, I assumed that this ratio holds good for the sub-groups, and reduced the number of employees for the sub-groups accordingly to arrive at the operatives."

Rostas felt that the definitions of "workpeople" used by the two censuses of production did not suggest incompatibility, but he agreed that further investigation of this point would be worth while.

(4.) Effect of short time working. In answer to Dr. Snow's criticism that consideration of short time working in Britain would increase its productivity indices, Dr. Rostas replied," Dr. Snow apparently does not notice that by giving up the per man comparison, and accepting - what I believe is more relevant - the output per-hour concept, he will get not an increase, but a great decrease in British productivity, owing to the average shorter hours worked in the U. S. . . ."

(5.) Appropriate rate of exchange for comparison of values. Since his comparisons were based mainly on physical quantities and net output figures had only a secondary importance, Dr. Rostas believed that the choice of rate of exchange could not affect the reliability of the estimates. He called Snow's

attention to his footnote on the conversion rates used in his estimates and stated that he "never thought for a moment that the market rate of exchange is the relevant rate for all groups of industry. . ."

(6.) The quality factor. Dr. Rostas denied that he "assumed that industrial efficiency was measured by production per head - both by physical output per head and by value of output per head," since he stated clearly in his paper that "for obvious reasons there was no possibility of making allowances for qualitative differences." He remarked that because American industry is more standardized and the range of products produced is lower, it has a great technical advantage. Rostas did not believe that there was a "general qualitative superiority of British over American products."

(7.) General comparability of the two censuses. Dr. Rostas believed Dr. Snow's paper might have left the impression that in comparing the scale or structure of productivity he used the gross output concept. Therefore, Rostas stated that he measured the scale of manufacturing mainly in terms of manpower, and additionally in net output and followed

this same method in dealing with the structure of production and productivity. The exclusion of small firms was not thought to have biased the productivity comparisons, especially as a high proportion of them was engaged in repair work. In reply to Dr. Snow's observations on the inaccuracies of the two censuses, Dr. Rostas answered, ". . . this is a point, which, if taken seriously would make it impossible to collect any national or international statistics. . ." There were two points on which both men fully agreed. They were that more comparable statistics ought to be collected and that there was a need for "specialist" knowledge of industries to check and elaborate on productivity calculations."

IV. In his paper on productivity and real income in the U. S. and U. K., Mr. T. Barna expressed the opinion that economic policy to increase the productivity of labour could not be laid down unless comparisons of productivity were made in quantitative terms, unless the differences in productivity were attributed to their appropriate causes, and unless the effects of alternative lines of policy were forecast. Barna discussed the concept of productivity, then the problems created by its measurement, and lastly the differences between productivity and standards of living. Barna remarks that:

> "Both productivity and production are relative and not absolute concepts; that is, they make sense only if comparisons of productivity or production are made between different periods of time or different areas."

The difficulties involved in the measurement of productivity were thought to result from theoretical problems concerned with the calculation of index numbers; from the nature of statistics available (firms and industries may use the products of another and may produce more than one product); from differences in the structure of industries; and from the fact that different things might be called by the same names (commodities described by the same name may differ in quality).

In summing up the factors influencing income per head in the two countries, Barna listed and estimated the effect of the following items: U. S. hourly productivity in industry (mining, manufacturing, and building) as compared with Great Britain; productivity in agriculture; low net output in agriculture; productivity in distribution and services; unemployment; relief work, rent of dwellings, and foreign income; age composition of the population on the labor force; education on the labour force; and other factors. He concluded that the ratio of U. S. income per head to the U. K. was 1.1 to 1.0, writing 1 as the U. K.

Using 1939 for the United States and 1938 for Great Britain, Barna tabulated employment, value of output, and value of output per head in the two countries and calculated net income figures. He divided employment into three broad catagories - commodity

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producing, commodity distribution, and service industries.

In regard to comparative productivity, Barna remarked:

> "The following ratios of productivity per man will be assumed, writing 1 for the U. K.: agriculture 1¼; mining 2½; metals 3; textiles and apparel 1½; food, drink and tobacco 1½; other manufacturing and utilities 2½; building and construction 1½. These figures are broad estimates, the one for agriculture based on a rough comparison of prices received by farmers in relation to net output per head. . ., the others are based on Dr. Rostas' calculations reinforced by the estimates given in the Reid and Bossom Reports. The index of productivity for industries other than agriculture averages 2.2 [or] 2.0. Including agriculture the index of productivity averages 1.8 or 1.9, writing 1 for the U. K. in each case. Now the index of total output comes to 3.63 using U. K. weights and 3.54 using U. S. weights. Since the ratio of the labour force in productive industries was 2.11 to 1, the index of volume of output per man comes to 1.72 or 1.68. This figure is lower than the index of productivity because net output per head (in value terms) is different in different industries, being relatively low, particularly in agriculture in which a higher proportion of U. S. population is engaged."

Productivity per head in commodity distribution was estimated at 1.35 with U. K. weights or 1.32 with U. S. weights (ratio of employment was related to volume of output to be distributed as calculated by Barna). The author felt that an estimation of productivity in the service industries presented "conceptual difficulties," but calculated that output per head in the U. S. service industries worked out to 5 - 6 per cent higher than in the U. K.

V. In 1948, Dr. Rostas published two monographs relating to productivity. In "Comparative Productivity in British and American Industry," he made the observation on his method of comparing physical output per head:

> "What makes physical output per head a good measurement of relative productivity is that it reflects the joint effect of a great number of influences on production. Relative physical output per head is influenced, for example, by differences in the skill and effort of the workers, but it is equally influenced by differences in managerial efficiency, differing technical equipment, rate of operations, and various other questions."

Supplementary indices, comparing the use of raw materials and fuel per unit of output and comparing the man-hours required to provide that part of the capital equipment which is used up in the course of current production, were considered necessary to complete productivity comparisons. Comparisons of fuel and power were thought to be of greater importance than those of other raw materials as they measured to some extent the substitution of human energy by other sources of energy. Output per worker was regarded as the fundamental index; for, given the existing capital equipment and natural resources, the "most important way of increasing wealth is by better utilization of the labour force. . ."

Rostas mentioned three methods of comparing productivity. The first was the global method which was based on the comparison of the total volume of output and employment in two industries

of different countries. This method was thought to be a fairly reliable measure of relative productivity in the sense that it showed "what the actual situation is and not what it would be under certain circumstances." Its limitation was felt to be that it resulted in a global figure which must be interpreted in view of "the physical environment" and "institutional factors" affecting it.

Additional difficulties arose from the definitions of an industry and a product and from the fact that this method didn't take into account either the indirect labor needed to maintain capital or indirect labor needed to produce fuel.

The sample method was based on the comparison of the performance of a small number of selected mills or factories producting identical products under similar conditions. The advantage of this method was found to be that it gave more information than the global method and concentrated on "what is, in many ways, the main aspect of the problem, the production methods closely associated with the type of technical equipment used." The fact that it tried to eliminate such factors as location and size was stated as one of its shortcomings.

The third method was the calculation of net output per head in the two countries, "converted into the same monetery unit at the purchasing parity rate in terms of the products

compared." The advantage of this method was declared to be that it took into account "quality differences in the product (in so far as these are reflected in the price), as well as in the labour force used; it also allowed for the different amounts of fuel and material used, which the global method did not do, and thereby served as a useful supplementary means of comparison." This method was thought to be a "good rough measurement provided the producers are making broadly the same sorts of articles, and that it is reasonable to presume that buyers are sufficiently well informed to insure that prices are kept fully well in line." The global method was the one largely applied by Dr. Rostas in his study.

Dr. Rostas defined the statistical techniques used in his application of the global method and came to the following conclusions in comparing British and American manufacturing industry:

(1.) In the pre-war period of 1935-9 average productivity in the 31 manufacturing industries compared, as measured by physical output per worker, was at least twice (about 2.2 times) as high in the united States as in Britain. If allowance were made for the shorter working week in the U. S., output per man was perhaps 2.8 times as high.

(2.) Differences in industrial structure could explain only to a small extent this higher productivity.

(3.) Differences resulting from the years chosen for comparison were relatively small.

(4.) Differences in productivity arising from variations in the average working hours per week in the U. S. and U. K. were "substantial" - the British worker "works on the average 27% more hours than the U. S. worker, and consequently the relative output per man-hour in the U. S. is about 27% higher than relative output per worker in the U. S. as compared with the U. K."

(5.) Differences in the ratio of salaried personnel to operatives was believed to have small effect on productivity comparisons.

(6.) The potential inclusion of non-manufacturing personnel, especially those engaged in distribution, in the figures for the labour force was felt to have small effect on the comparisons.

(7.) Differences in the amount of energy used or the way in which it is generated was estimated to have a "probably small" influence.

(8.) The fact that raw materials are received in certain British industries in a less prepared stage than in equivalent American industries was of "little importance."

(9.) The fact that the proportion of females in the labour force was lower in the U. S. than in the U. K. would appear to result, on an "equivalent man basis" in the ratio of productivity of industry as a whole being about 10% less favorable to the U. S.

Dr. Rostas devoted a good deal of attention to the factors affecting productivity differences. These factors are both specific and general. "Specific factors operating in particular industries of different countries" are found to influence output per workers. Physical, geographical and geological factors are given as pertinent illustrations of such influences. For example, the author stated:

> "It is generally known that the high output per man-shift in the U. S. coal mines is due to their favourable natural conditions, which finds no parallel elsewhere. . ."

"Institutional factors" as output restrictions (cartels or trade unions) or taxation policies are given as another class of specific conditions affecting productivity. Dr. Rostas felt that the "British system of motor taxation until 1947 has had a profound effect on engine design and indirectly on standardization." Included in this discussion of specific factors were economic conditions, the type of market for instance, which could affect output per worker.

The general factors affecting productivity were classified under three headings: differences in the degree of capital intensity; factors bearing on capital intensity; and factors other than mechanization and production technique affecting output per worker.

The most "immediate factor" which was thought to influence productivity was the amount of machinery available - a factor

which depended on such things as the size of the plant or firm. The author qualified this statement with the observation that the "installation of machinery in itself will not procure high output per worker unless production is sufficiently standardized to allow the economical use of this machinery. . ." The author suggested that "in so far as direct labour is replaced by capital," capital has to be related to output (and not to labour) as this "will indicate the degree of substitution of one factor of production for the other, as well as the total amount of real resources used per unit of output." In measuring capital equipment available per worker by horse power per worker, Rostas found that there was no suggestion of any "close correlation between the relative amount of horse power per worker and relative productivity." He concluded:

> "Horsepower per worker, is at best, an indicator of the quantity of machinery available, and this is not the only characteristic of capital equipment in which we are interested. The quality, size (type, efficiency, etc.) of the machines as well as the application of modern technique in general, is of equal importance, even though it cannot be approached by a general quantitative survey, but only by an industry to industry analysis."

It was also pointed out that general trend of manufacturing technique wasn't entirely involved in increasing the amount or horsepower of machinery, but included such things as increase in speed of machines, elimination of hand operations, and technical changes in materials used. Information thought to be helpful in determining the quality of machinery was data on the age of

available equipment and the rate of replacement of capital equipment. In analyzing the possible connection between the proportion of labor engaged in producing capital goods in the United States with the high productivity of this country, Rostas determined that his estimates did not indicate a higher proportion of labour so employed in the U. S. as compared with Britain. He found that "the proportion is probably very nearly equal in the two countries, though perhaps somewhat lower in the U. S." and "considering the higher output per worker in the U. S. machine-making industry this also means that either the addition to the capital stock or rate of replacement or both are quicker in the U. S. than in Britain."

In discussing factors bearing on capital intensity, it was concluded that while in certain industries the size of the market has an influence on output per worker, it was not as great "as is generally assumed;" and that there does not seem to be any definite relationship between the size or "concentration pattern" of plants and "high relative productivity." The importance of standardization received emphasis and Rostas stated that "all aspects of it have a bearing on industrial efficiency."

Other factors besides mechanization and technique of production which were thought to influence productivity were organi-

zational (factory lay-out, planning, flow of goods, etc.) and dependent on managerial skill. Some were connected with labor and included such things as the number of hours worked, the wage system, methods of work simplification, labour turnover, and psychological attitudes.

Rostas attempted to reconcile a "higher U. S. productivity with a somewhat higher U. S. real income per head" on the basis of productivity comparisons. He found that the results of the study were "necessarily approximate," but indicated that "for Britain by far the most important way of increasing the standard of living of the population is to increase productivity in the manufacturing industry."

VI. In the final paper considered, "Productivity, Price, and Distribution in Selected British Industries," Rostas presented the "results of an exploratory investigation into variations of prices, costs, and efficiency in different sized firms in British industry in 1935." Only one section of this monograph compared British industries with United States industries. In discussing the relationship between the size of the firm and efficiency, Rostas remarked:

> "It is interesting to note that an inquiry in the U. S. covering very largely the same range of industries, but with homogeneous products, found a much more obvious and clear-cut relation between increasing size of plant and increasing efficiency."

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the output of Britain in 1935 is taken as 100, German output in 1936 was 127, the United States output was 320 in 1935 and 430 in 1937. Since German output exceeded British output in about the same ratio as German industrial employment exceeded the British, it follows that productivity (*i.e.*, output per head) of British and German industries was roughly the same, while the productivity of the United States was about twice as large.[1]

B. *The Structure of Manufacturing Industry* (Table IV)

(iii) The proportionate importance of the different branches of manufacturing in aggregate output produced and in total

TABLE IV

The Structure of Manufacturing Production

Proportionate importance of different branches of industry in total output and employment.[1]

(Percentages)

Trade.	United Kingdom, 1935.	Germany, 1936.	United States.		United Kingdom, 1935.	Germany, 1936.	United States.[2]	
			1935.	1937.			1935.	1937.
	Net Output.				Employment.			
Iron and steel	3·9	16·5	11·2	13·6	10·6	16·1	12·2	13·6
Engineering, shipbuilding and vehicles	21·0	21·4	18·3	21·3	21·4	19·4	16·1	18·4
Non-ferrous metal	2·5	2·4	3·1	3·4	2·4	1·8	3·0	3·2
Chemicals	7·4	9·0	9·8	9·5	3·8	5·0	5·2	4·9
Textiles	13·3	11·0	8·0	7·2	20·5	15·2	15·1	13·4
Clothing	6·9	4·0	7·7	6·3	10·4	5·6	11·5	10·5
Leather	0·9	1·0	1·4	1·1	0·9	1·5	1·5	1·4
Rubber	1·2	1·0	1·7	1·5	1·1	0·9	1·6	1·5
Clay and stone	4·5	6·7	3·2	3·5	4·8	9·5	3·2	3·5
Timber	3·2	4·0	4·7	5·0	3·8	6·1	8·0	8·1
Paper and printing	9·5	5·7	11·8	10·5	7·9	6·4	7·5	7·2
Food, drink and tobacco	17·0	14·0	16·5	14·6	10·1	10·2	12·3	11·4
Miscellaneous[3]	2·5	2·4	2·6	2·5	2·4	2·3	2·8	2·9
Total factory trades	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

[1] Computed from Censuses of Production data. German and American data were regrouped to cover British categories.
[2] Based on number of operatives.
[3] Includes scientific instruments, games, toys, sport requisites, etc.

employment is fairly similar in all the three countries. The most important deviations in the order of importance of broad industrial groups are the slight preponderance of heavy industries

The same publication of the German Institute of Business Research calculates also a dollar-mark conversion rate, on the basis of relative purchasing power, which yields a purchasing-power rate of $4·68 to the £.

[1] The exact figures of average productivity per head are: Britain, 1935 = 100, Germany, 1936 = 109, U.S.A., 1935 = 199, U.S.A., 1937 = 227.

and the relatively smaller importance of consumption industries in Germany (as compared with both Britain and the United States). This may be partly due to the much greater armament expenditure in Germany in 1936, and also to the fact that in certain consumption-goods industries (such as clothing and printing) handicraft—which is excluded from the Census—is still of great importance in Germany. In Britain textile trades are still relatively preponderant (they employ over one-fifth of the total labour force in manufacturing in Britain, but only about 15 per cent. in Germany and the United States), while in the United States the importance of timber trades and chemicals (including petrol refining) is relatively greater.

(iv) As regards *individual industries*, the most significant deviations in their order of importance are the preponderance of heavy chemicals, tobacco, stone, machine tools, scientific instruments and sugar trade in Germany, lumber and timber products, meat packing, petrol refining, non-ferrous metal alloys, rayon, paper boxes in the United States (both as compared with the United Kingdom).

C. *The Productivity per Head in the Different Countries* (Tables V, VI)

(v) We have attempted two different methods of comparison, one based on physical output per head, and the other on the value of output per head. The comparison of industrial efficiency, based on *physical* output per head in the different industries of the three countries, involved numerous difficulties. These were due to the fact that individual industries, as classified by the Censuses, each produce a group of products and by-products which are not identical in the different countries, either as regards type or quality or relative importance of individual types within the group. As a result, comparisons of physical output per head could only be made for a certain number of industries for which quantitative data were available, and the output could be reduced to homogeneity.[1]

These comparisons, which are given in Table V, largely confirm, however, the results obtained by comparing output per head on the basis of the *value* of output as shown in Table VI, that industrial efficiency—as measured in production per head—was roughly similar in Great Britain and Germany, while in the United States it was more than twice as great as in the two other

[1] For the actual methods of measurement adopted vide note to Table V.

TABLE V

Physical Output per Head in Certain Manufacturing Industries and Mining [1]

(In index numbers)

Trade.	United Kingdom, 1935.	Germany, 1936.	United States, 1937.
A. Mainly Capital-goods Industries and Mining.			
Coal	100 (1936)	143 (1936)	263 (1936)
Blast furnaces products	100	115	361
Smelting and rolling of iron and steel	100	114	168
Iron and steel foundries	100	120	186
Iron and steel products (wire, cutlery, iron stoves, tools and implements) [2]	100	95	(400)
Machinery [3]	100	110	(280)
Cement	100	92	106
Coke	100	152	221
Printing ink	100	82	186
B. Mainly Consumption-goods Industries.			
Motor cars	100	98	419
Radio sets	100	70	482
Cotton spinning	100	120	120
Cotton weaving	100	68	130
Rayon and silk	100	132	160
Jute trade	100	106	130
Hosiery [4]	100	92	140
Boots and shoes	100	110	165
Rubber tyres	100	117	266
Breweries	100	67	104
Tobacco manufacturing	100	30	171
Soap	100	117	279
Margarine	100	81	168
Beet sugar manufacturing	100	..[5]	162
Preserved food and vegetables	100	50	145
Wheat milling	100	93	160
Total (A). Mainly capital-good industries and mining:			
Unweighted average	100	111	240
Weighted with British net output		123	256
Weighted with German net output		117	256
Weighted with American net output		116	241
Total (B). Mainly consumption-good industries:			
Unweighted average	100	88	184
Weighted with British net output		87	217
Weighted with German net output		79	195
Weighted with American net output		85	211
Grand total. All trades covered by the sample [5].			
Unweighted average	100	97	206
Weighted with British net output		107	238
Weighted with German net output		101	231
Weighted with American net output		104	229

[1] The above index numbers should be regarded as merely in the nature of rough approximations. It must also be borne in mind that the indices relate to output *per operative*, without any corrections for man-hours, while the normal weekly man-hours showed wide divergences in the three countries. The average weekly hours actually worked in manufacturing industry in the United States were 38·6 in 1937 (*Statistical Abstracts*, 1940, p. 336). The average weekly normal hours in the British Census trades amounted in 1935 to 47·2, and the average actual working hours in the week ended Oct. 12, 1935, to 47·8 (computed from data in the *Ministry of Labour Gazette*, 1937, p. 258). German statistics give the average daily hours in manufacturing industry in 1936 with 7·59 and indicate about 45 average weekly hours (*Wirtschaft und Statistik*, 1938, Nr. 8).

SOURCES: Data of the Censuses of Production, supplemented with other material published in the *Statistical Abstracts for the U.K.* and *Statistical Abstracts for the U.S.*, *Reports of the Secretary of Mines*, *Statistics of the Iron and Steel Industries* (British Iron and Steel Federation), *Statistical Yearbook of the League of Nations*, etc. Production data for a great many industries are published for Germany in *Statistisches Jahrbuch fuer das Deutsche Reich*, 1938 (and 1936), which were combined with Census data on employment, etc. Further German sources used were *Wirtschaft und Statistik*, passim, and publications of the German Institute of Business Research.

METHOD: The method followed was that of computing quantitative data of the production of comparable commodities (or group of commodities), and discovering the number of operatives producing the respective quantities. Where the trade to be compared produced more than one commodity (say coke and gas) or different types of the same commodity (shoes for men and women), they were converted into one homogeneous product, either on the basis of physical weights (as in case of steel products or tobacco products) or on the basis of their relative values (as in case of different kinds of shoes or motor-cars). For obvious reasons, there was no possibility of making allowances for qualitative differences (thus a standard American motor-car was regarded

countries.[1] This takes no account of the wide differences in the number of weekly man-hours; on an output per man-hour basis, the superiority of the United States would be even greater. As regards the efficiency of labour in individual industries, Germany appears to be somewhat superior to this country in the capital-goods industries, and somewhat inferior in the consumption-goods industries; and similarly the superiority of the United States is greater in the capital-goods trades than in the consumption-goods trades.

As between Britain and Germany, the German superiority is particularly marked in coal-mining and coke manufacturing, and also (surprisingly enough) in cotton-spinning and rayon and silk production. She is greatly inferior in many important food trades, like tobacco, preserved foods, breweries, and also in

[1] It is interesting to observe that *real income per head*, as shown by national income statistics, was not significantly greater in the United States than in Britain. Thus, for 1938 (for which year comparative data are available, cf. R. Stone, "The National Income, etc., of America, 1929 41," ECONOMIC JOURNAL, June September, 1942), U.S. income per head was $526, British income per head £98, thus the relation at the conversion rate of $4.89 to the £ was 110 per cent. From the point of view of cost of living (as against wholesale prices of manufactured goods) the appropriate conversion rate was not the market rate of $4.89, but $6.53 to the £, mainly because of the much higher level of rents in the United States (cf. data in *An International Enquiry into Costs of Living*, I.L.O., Geneva, 1931, adjusted for 1938 with the help of cost-of-living indices). On this rate of conversion, however, in 1938 American real income per head was only 82 per cent. of the British. (It should be noted that the ratios of real income per head for the year 1937 were only slightly more favourable for the U.S., as the higher per head national income was counterbalanced by less favourable conversion rates than in 1938.)

The reasons for this discrepancy between the relation of industrial output per head and real income per head have not so far been satisfactorily accounted for. The apparent reasons are (*a*) that a smaller proportion of the U.S. population is engaged in manufacturing, and a smaller percentage of the total population is occupied, (*b*) that in the other constituent elements of the national income – *i.e.*, agriculture, transport, housing, distribution – the productivity relation is not so favourable to the U.S. as in manufacturing. In particular, the fact that Britain obtains a considerable part of its peace-time food supply from abroad on favourable terms probably implies that the amount of food obtained per British man-hour is large relative both to the U.S. and Germany.

as equivalent to a standard British or German motor-car). In order to arrive at the number of operatives employed in producing the volume of output compared, it was necessary to exclude operatives producing by-products not included in the comparisons or those doing repair work, etc. In many cases this was possible only by assuming that the net output per head within the same industry was the same irrespective of whether the operative was engaged in producing the main product, or the by-product, or was engaged in doing repair work. It is obvious, therefore, that much arbitrariness was involved in these calculations in almost every single case, and some of the indices – for reasons stated below – are highly conjectural.

[2] German volume data based on individual Censuses of 1929 and 1933, adjusted with the help of data in the 1936 Census (which contains value data only), and price indices. American index based on comparisons of value of net output produced per head of operatives.

[3] Vide footnote 2.

[4] American index partly based on comparison of the value of net output produced per head of operatives.

[5] American index partly based on comparison of the value of net output produced per head of operatives. It includes for the United States canning trades.

[6] Little less than half of the total net output is covered. A more representative proportion of consumption-goods trades is covered than of capital-goods trades.

TABLE VI

The Value of Net Output per Head of Operatives in Britain, Germany and the United States

(In £, and in index numbers)

Trade.	United Kingdom, 1935.		Germany, 1936.		United States, 1937.	
	£.	Index numbers.	£	Index numbers	£.	Index numbers.
Iron and steel	239	100	291	122	596	249
Engineering, motor shipbuilding	270	100	339	126	686	254
Non-terrous metal	283	100	403	142	642	227
Chemicals	617	100	651	106	1,145	186
Textiles	159	100	205	129	318	200
Clothing	168	100	218	130	356	212
Leather	237	100	270	114	417	176
Rubber	312	100	341	109	575	184
Clay and stone	238	100	195	82	588	247
Timber	215	100	192	89	369	172
Paper and printing	332	100	260	78	867	261
Food, drink and tobacco	187	100	417	86	760	156
Miscellaneous	270	100	256	95	575	213
Total factory trades	264	100	294	111	595	225

Note. Computed from Censuses of Production data. Rates of conversion used were $4.94 to the £ and Rm. 17.08 to the £. It must be emphasised that the conversion rates were chosen to correspond to relative purchasing power in terms of commodities in general, and not (or not necessarily) in terms of the products of the individual industrial groups. To the extent the purchasing power parity in terms of these individual groups would yield different results, the figures in the above table must be considered arbitrary.

cotton weaving and hosiery. The greatest superiority of the United States is in the radio and motor-car industry, and in iron and steel products, where output per head is four times as great as in Britain, and in pig-iron production and machinery, where it is threefold. It is interesting to note that the United States has a superiority in each single industry covered by our sample.

(vi) We have also compared the *value* of net output per head for the different industrial groups in the three countries (in Table VI). On the basis of the conversion rates given on pp. 42–43 above, the results were not significantly different (with the exception of textile trades) from those obtained from the comparison of physical output. The comparison shows a German superiority (as compared with Britain) in metal trades, textile trades and chemicals, while Britain is superior in clay and timber trades, paper trades and food trades. The United States still shows a superiority in all big branches of manufacturing, and this superiority appears to be most conspicuous in the heavy industries.

(vii) It is interesting to note that *the variations of the values of output per head as between one industry and the other* are also rather similar in the three countries. The value of output per head is round the average in metal trades, it is much above the average in chemicals and food trades, and below the average in textile and clothing trades, timber trades and clay and stones. Leather, clay and paper and printing industries show relatively higher produc-

tivity (in comparison with average productivity) in the United States than in the other countries. (Too much significance must not, however, be attributed to these variations in the value of the output per head between the different industries, as they may be merely reflections of the influences which cause corresponding variations in the share of wages and the share of profits.)

D. *Long-Term Changes in Productivity* (Table VII)

(viii) The long-term trend in productivity—as measured by relating indices of physical production to indices of employment

TABLE VII

Long-term Changes in Productivity in Manufacturing Industry in Britain, Germany and the United States

(In index numbers, 1929 = 100)

	United Kingdom.			Germany.		
	Production. (1)	Employment. (2)	Output per head. (1) : (2)	Production. (3)	Employment. (4)	Output per head. (3) : (4)
1929	100	100	100	100	100	100
1930	92	93	99	78	87	90
1931	82	85	97	72	72	100
1932	81	84	98	58	60	98
1933	90	88	103	65	66	99
1934	102	92	111	85	84	102
1935	109	94	117	97	92	106
1936	119	99	120	110	101	109
1937	126	105	120	122	111	110
1938	113	102	111	133	117	113

	United States.					
	Production.		Employment.		Output per head.	
	a. (4)	*b.* (5)	*a.* (6)	*b.* (7)	*a.* (4) : (6)	*b.* (5) : (7)
1929	100	100	100	100	100	100
1930	—	83	—	87	—	95
1931	66	67	74	74	90	91
1932	—	52	—	61	—	83
1933	62	62	69	69	90	89
1934	—	67	—	81	—	83
1935	75	78	86	86	87	91
1936	—	95	—	93	—	101
1937	97	103	102	103	95	100
1938	—	79	—	85	—	94
1939	—	98	—	91	—	108

a. Censuses of Manufactures Indices.
b. Federal Reserve Board indices of production and employment.

SOURCES:

BRITAIN. Production. *L. and C.E.S. Annual Inder.* It excludes building and contracting. This series follows very closely the indices based on Census results for the Census years. Employment indices, constructed by R. Stone on the basis of insurance statistics allowing for unemployment. Both series quoted from Stone, R., and W. M.: "Indices of Industrial Output" (ECONOMIC JOURNAL, 1939, p. 477). Basis changed to 1929 = 100.

GERMANY. For 1933-38 indices of industrial production computed by the Office of Planning for War Economy. For previous years indices of production of the German Institute of Business Research. The former index based on indices of 153 special trades shows greater increase than other German indices of production relating to the same years (vide *Die deutsche Industrie, op. cit.*, p. 39, and *Weekly Reports of the German Institute of Business Research, passim*). Employment indices were computed on basis of data in *Wirtschaft und Statistik*, 1938, Nr. 8, and 1939, Nr. 8.

UNITED STATES. Compiled from data given in the *Statistical Abstracts of the United States*, 1940, pp. 803, 804 and 340.

Rostas, L., "Industrial Production, Productivity, and Distribution In Britain, Germany, and the United States," The Economic Journal, Volume LIII, Number 209, April 1943.

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Comparison of Productivity in Agriculture: United Kingdom, United States, Germany.(1)

	U. S.	U. K.	Germany
Agriculture	1937	1937-8	1937-8
Value of net output	$6,361mn.	£ 175mn.	Rm. 10,584 mn.
Estimated employment	10,892,000	1,100,000	8,500,000 or 6,600,000*
Net output per head:			
In agriculture -			
(a) in original currencies	$584	£ 159	Rm 1,245 or Rm 1,554*
(b) at official exchange rates of 4.94 and Rm. 17.08 to £	£118	£159	£ 73 or 90*
(c) at purchasing parity rates, 3.52 and Rm 16.86 to £	£166	£ 159	£ 74 or 91*
(d) as index numbers	104	100	47 or 57*

*after deducting 1,600,000 wives, included as family helpers (on the assumption that three out of four wives were originally included in the census data. If the labour force were expressed in equivalent men, Germany would compare more favourably with the U. K. and U. S.)

1. Rostas, L., Comparative Productivity In British and American Industry, N. I. E. S. R. Occasional Paper XIII, p. 78.

1 * **

A Summary of Productivity Comparisons

			U. K. (approx. 1935-9)	U. S.
1. Manufacturing			100	21[illegible]
2. Mining			100	42[illegible]
Broken down into	Fuel		100	[illegible]
	Iron Ore		100	20[illegible]
	Other Mining		100	3[illegible]
3. Public Utilities and Communications			100	23[illegible]
Broken down into	Electricity		100	19[illegible]
	Manufactured Gas		100	16[illegible]
	Post, Telephone, Telegram		100	27[illegible]
4. Building and Construction			100	11[illegible]
5. Agriculture and Fisheries			100	10[illegible]
Broken down into	Agriculture		100	10[illegible]
	Fisheries		100	79
6. Transport:			100	
(a) allowing for distances			100	(270-300)
(b) not allowing for distances			100	(100-110)
of which	Railroads	(a) Ton miles	100	40[illegible]
		(b) Passengers and freight	100	82
	Buses	(a) Bus miles	100	28[illegible]
		(b) Passengers	100	10[illegible]
	Trams	(a) Car miles	100	19[illegible]
		(b) Passengers	100	11[illegible]
Road haulage			100	(10[illegible])
All transport activities concerned in carrying:				
(i) Passengers			100	(12[illegible])
(ii) Goods			100	(93-106)
7. Distribution			100	(150)
8. Finance, etc.			100	(10[illegible])
9. Services and Government**			100	(17[illegible])
Weighted average				
(a) Weighted by British employment			100	(18[illegible])
(b) Weighted by U. S. employment			100	(16[illegible])

* Comparisons refer, broadly speaking, to the last pre-war years (i.e. the years between 1935 and 1940), but not necessarily to the same years for each pair of industries

For the sake of simplification the range of differences, due to different methods of weighting, were omitted and averages only given.

** For Transport, estimate (b) was taken.

(Continued)

(Continued)

"This comparison indicates that U. S, advance in output per head is not as great in most of the branches of her national economy as in manufacturing. It is higher in mining than in manufacturing, due mainly to natural conditions, and the American advance is largely on the same level in public utilities as in manufacturing. The U. S. has, however, a lower superiority in physical output per head in the services, distribution, building and construction industries, though there is still a superiority. Lastly, output per head appears to be on the same level in agriculture and (on certain assumptions) in the transport industries of the two countries. While in manufacturing physical output per head appears to be well over twice as high in the U. S. than in the U. K., in all branches of the national economy analysed this is reduced to 1.6 - 1.8."(2)

(1.) Rostas, L., Comparative Productivity In British and American Industry, N. I. E. S. R. Occasional Paper XIII, p. 89.

(2.) Ibid., p. 90.

INCREASING PRODUCTIVITY

A report on the studies conducted by teams
of the Anglo-American Council on Productivity

On the initiative of Sir Stafford Cripps, Chancellor of the Exchequer of the United Kingdom, and Paul G. Hoffman, Economic Cooperation Administrator of the United States, the Anglo-American Council on Productivity was established in 1948. It consists of representatives of management and labor from both countries.

The Council, convinced that British and European economic recovery would be greatly accelerated by increased productivity, sponsored, as one of its programs, visits to the United States by selected teams representative of British industry. Between October 1949 and November 1950, nineteen teams made such trips -- thirteen were representatives from all levels of specific industries as steel founding, pressed metal, and diesel locomotives. While six were representatives of industry-wide operations as materials handling, packaging, and management accounting. The individual reports usually included specific observations and recommendations pertaining only to technical aspects of their particular industry. More general observations were also discussed, and the reports, when taken collectively, give an insight into the major factors involved in the whole problem of how to achieve greater productivity. These factors may be grouped under the following headings: Psychological Attitudes, Technology, Labor, Management, Trade Unions Markets, Research, and Government Policies.

1. The "productivity consciousness" of all levels of industry from the most unskilled worker to top management is emphasized in all of the reports as being essential to the attainment of greater productivity. The workers' sharpened sense of the importance to them of attainment of greater productivity and the awareness of their contribution to its

accomplishment makes labor more receptive to the techniques of scientific management and to the advancements in technological processes. The reports agree that management should also realize the need to accept change and to try new methods without being bound by ties of custom and tradition. Reference is made to the fact that both labor and management need to be conscious of the cost factor in production to obtain its optimum reduction and need to be conscious of the importance of safety precautions on an individual basis so that unnecessary physical protection, which may decrease productivity, can be eliminated. This last point was of special interest to the Pressed Metal Team which reported:

> "In many plants visited there was a complete lack of guarding as understood in Britain and estimates by members of the team indicate that in certain press operations, the effect was an added productivity of 20%."

These attitudes and realizations are found to be stimulated by defining the link between the standard of living and productivity; by increasing the rapport between labor and management through the lessening of class distinctions and the encouraging of a "team spirit;" by eradicating any stigma placed by society on those entering industry as compared with a profession; and by having fair working agreements and good working conditions. The situation with regard to the supply of labor was noted by some of the reports as having an effect on productivity. The Internal Combustion Engine Team stated that:

> "Labor is plentiful and it would appear that fear of dismissal is certainly one reason for the high standard of

The members of the Grey Iron Foundry Team also considered the effect of the labor supply on productivity, but expressed the following opinion:

> "It may, therefore, be concluded that there is today a greater fear of unemployment in America than in Britain, but it is not so certain that this fear leads to greater production. The team thinks that this is a probable, but not a certain consequence. .....Nevertheless, the team does believe that the British policy of full employment has removed an incentive to effort -- but whether this is a desirable policy or not is beyond the Team's proper scope for comment."

In the estimation of most of the teams, these psychological attitudes have an important influence on productivity. The members of the Building Team claimed that:

> ".....a large part of the difference between American and British productivity can be accounted for only by the individual attitude towards work, an attitude which reflects the general pattern of American industrial life."

2. The extended use of power and mechanically operated machines is a factor which is found to affect productivity. An adequate supply of electric power is brought out as being essential to increased productivity. The Cotton Weaving productivity team reported that for utmost efficiency machines ought to combine high speed with versatility so as to reduce manual effort but retain flexibility. Machines

that even the most unskilled worker can manipulate are recommended as an advantage to increased output. The reports which discussed the need for the best machine utilization were in accord that the work ought to flow uninterrupted and handling ought to be minimized. In regard to the layout of the plant, the concensus of opinion is that great care should be given to the spatial relationships of men and machines. In this connection it is agreed that the designing and planning stages should precede the operational. Close collaboration between the machinery suppliers and manufacturers is suggested to facilitate the procurement of proper equipment. In the interests of efficient machine utilization, the Cotton Weaving team advised:

> "Where the working unit is small, consideration should be given to the possibility of extension to the optimum size for efficient working with modern machinery or, alternatively, amalgamation with similar interests to permit the sharing of technical personnel and expensive machinery which would not otherwise be utilized fully."

This productivity survey recognized that technology can increase productivity with little capital expense merely by increasing the efficiency of existing machines and plants.

The members of the productivity teams felt that the efficiency of existing machines andplants could be increased by the use of specialization, simplification, and standardization. It is judged likely that specialization can reduce losses from change-overs and special handling arrangements; because, by concentrating technical and manufacturing skill on a narrow range of products, the specialist can have long production runs. Long

production runs are believed to be conducive to an accumulation of orders and to the acquisition of a reliable source of supply which may increase efficient production. The teams' reports conclude that simplification reduces variety of products and costs - especially tooling costs. Consequently, service and maintenance is rendered more easy, and the preventive aspect of maintenance can be emphasized. The training of operatives may also be expedited. The Simplification team felt that one of the major reasons for high productivity and low costs in the United States is the "ruthless elimination of unnecessary variety and the resultant concentration of manufacturing resources." Many of the reports emphasized the importance of standardization in achieving greater productivity. The Pressed Metal team found that to attain "large volume production in Britain, a much higher measure of standardization is needed." The packaging team observed that standardization meant more than "dimensional uniformity" as it included standardization of type and style. It believed that:

> "Standardization has the effect of stimulating a sense of relationship. The design of the pack, the layout of the packaging line, and the make-up of a product range are brought together as an entity."

The Management Accounting representatives pointed out the fact that "quality does not suffer as a result of standardization or mass production." The steel founding team noted that it was this belief that "standardization involves compromise" which was responsible for British opposition to it and emphasized that:

"It is essential to concentrate upon the essentials, and to resist any compromise upon them, but to be ready to sacrifice every element of design which is inessential in order to conform to standards."

3. Complete and efficient labor utilization is considered to be another important contribution to high productivity. The Men's Clothing representatives stated that the breaking down of jobs into their simplest components enabled workers to "specialize in particular operations" and "acquire a high degree of skill which is increased by experience" in a relatively short time. It is deemed likely that utilizing labor on a shift basis can allow the continuous operation of machines and reduce losses from unproductive breaks in the flow of material. A further conclusion is drawn that unproductive breaks also can be reduced by seeing that skilled labor is properly serviced by unskilled labor so it does not waste time on ancillary functions. The reports repeatedly stress the need for a wage structure that is simple, that is based on a flat rate plus productive bonuses, and that differentiates sufficiently between rates for skilled and unskilled workers to provide an incentive for greater productivity. Productivity of labor is additionally affected by working conditions (light, temperature, ventilation, cleaning facilities), training programs, absenteeism, and the restrictions imposed by an apprenticeship system. The labor factor is of special importance to the teams investigating productivity for the emphasis in the entire study is placed on output per man-hour rather than output of the total factory.

The Internal Combustion Engine team declares:

"Greater attention must be paid by management to the efficient use of labor. The output of each individual, rather than the over-all output of the factory, is the point requiring study."

4. The productivity teams' reports reveal that another major factor exerting considerable influence on productivity is management. Management is acknowledged as having the responsibility to maintain a thorough knowledge of all aspects of its plant and industry. The responsibility of management is also to develop, coordinate, and implement methods of scientific management. To steer consumer demand toward acceptance of a simplified and standardized product range, well organized sales and advertising staffs are considered a necessity. Close collaboration between these staffs and the production and design departments is advised along with close collaboration between management and suppliers to achieve the best employment of long-run, low-cost production.

The expansion and improvement of plant and equipment is thought to be dependent on an adequate supply of capital for investment. A pertinent view expressed in the Grey Iron Founding report is that a relationship exists between productivity and the degree to which a banking system is centralized. That team feels that a banking system which is decentralized might be more inclined to interest itself in financing the industrial expansion of local interests. Conservative lending habits of banks could also affect productivity by curtailing the amount of capital at the disposal of investors.

5. The mutual responsibility of management and labor in promoting prompt settlement of labor disputes is emphasized since poor labor relations reduce productivity. The role of the trade unions is believed to consist basically of fostering the understanding of the need for high productivity and the acceptance of the principles of scientific management among the rank and file of union members. The acquisition of technical staffs and facilities for studying methods and results of scientific management may enhance the intelligent union handling of problems arising from their application. Through such activities the teams feel that unions can stimulate the collection and exchange of productivity data.

An interesting point reported by an independent survey published in 1950 by the British Trade Union Congress entitled, "Trade Unions and Productivity" is that union drives to make "similar bargains" in all companies forces a general rise in the level of productivity by compelling the least efficient plants to improve methods so profits can be raised to meet union demands. Another view expressed by this survey stated that contracts between labor and management negotiated on a local rather than national basis render agreements less complicated and emphasize individual company technique and efficiency.

6. The market for any given output produced by the combination of all the factors in productivity is required, in the opinion of some of the reports, to offer ample scope to permit the development of long production runs resulting from the application of the processes of simplification, standardization, and specialization. The Packaging Team

report, however, concluded that a large market with great distances may somewhat obviate the advantages of the availability of numerous customers with high distributitive costs. They say:

> "Too often .....the level of efficiency in American factories is attributed to the numerical size of the home and export markets. Distances and the high cost of transport reduce the effective radius of distribution from a given factory to something much nearer to our own than we are usually prepared to admit."

To be effective in increasing productivity, the market demand should be receptive to the assimilation of a lessvaried range of products and should be relatively easy to predict.

7. It is generally accepted in the teams' reports that the accurate prediction of market demands requires continuous research. A well developed research program may assist the designing and planning activities of a firm by making possible the long-term forecasting of requirements and situations with which the companies may be confronted. Research centrally organized on a national as well as an industry basis is thought to contribute to productivity by making easier the free exchange of ideas and results from relevant studies.

8. Many of the productivity teams devoted a section of their findings to the influence of government on productivity. They indicated that government sponsored programs for the collection and dissemination of information on manufacturing techniques and manpower utilization may increase productivity, but that other government policies are likely to have more direct effect. The significance of taxation policies was treated

by some of the teams. In the view of many of them, if a slight increase in a worker's gross earnings results in a relatively large increase in income tax liability, the incentive of the individual to raise his earnings through greater productivity may not be effective. High direct taxation of company profits was presented as another limitation on incentive to increase productivity. For when profits are high in prosperous times, it is difficult to build up reserves for capital investment. This is declared to have an especially restrictive effect in countries such as the United Kingdom where investments traditionally are made from accumulated profits rather than from outside loans.

Government import and export regulations, controls over materials and methods, restrictions on licensing, quotas, and price agreements are listed as factors influencing productivity. Several teams made the observation that a highly competitive market under a system of private enterprise tends to reduce costs and increase productivity. The Management Accounting representatives observed:

> "American management's perception of the need for high productivity at low cost is sharpened by the knowledge of the penalty of failure, possible loss of business to competitors, and ultimate bankruptcy."

The industrial productivity teams, while admitting the need for a method of measuring productivity, felt that obtaining an accurate measurement of all the variable factors included in the problem posed difficulties with which they were not prepared to cope. A special report published in November of 1950 by the Council entitled, "Productivity Measurement in

British Industry" emphasized the necessity for it and the complications involved in it, but did not completely present a solution. It dealt with a method of measuring changes in technology and labor utilization ir terms of time indices computed by time study engineers, but gave no indication of how the individual factors and their variations were measured or weighted.

These reports published by the Anglo-American Council on Productivity recognize in some detailthe multiplicity of factors affecting productivity. An inclusive list of such items is important. A method of measuring the influence of such factors also would have been of great value.

LIST OF REPORTS

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3. British Trade Union Officials' Team, "Trade Unions and Productivity", British Trades Union Congress, London, 1950.

4. Cotton Weaving Productivity Team, "Cotton Weaving", Anglo-American Council on Productivity, London and New York, June 1950.

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6. Diesel Locomotive Productivity Team, "Diesel Locomotives", Anglo-American Council on Productivity, London and New York, November 1950.

7. Electric Motor Control and Small Airbreak Switch Gear Productivity Team, "Electric Motor Control Gear and Small Airbreak Switchgear", Anglo-American Council on Productivity, London and New York, September 1950.

8. Fertilizer Productivity Team, "Superphosphate and Compound Fertilizers", Anglo-American Council on Productivity, London and New York, July 1950.

9. Grey Iron Founding Productivity Team, "Grey Iron Founding", Anglo-American Council on Productivity, London and New York, September 1950.

10. Internal Combustion Engine Productivity Team, "Internal Combustion Engines", Anglo-American Council on Productivity, London and New York, June 1950.

11. Management Accounting Productivity Team, "Management Accounting", Anglo-American Council on Productivity, London and NewYork, November 1950.

12. Materials Handling Productivity Team, "Materials Handling in Industry", Anglo-American Council on Productivity, London and New York, May 1950.

13. Men's and Youths' Factory Tailored Clothing Productivity Team, "Men's Clothing", Anglo-American Council on Productivity, London and New York, June 1950.

14. Packaging Productivity Team, "Packaging", Anglo-American Council on Productivity, London and New York, September 1950.

15. Pressed Metal Productivity Team, "Pressed Metal", Anglo-American Council on Productivity, London and New York, July 1950.

16. Rayon Weaving Productivity Team, "Rayon Weaving", Anglo-American Council on Productivity, London and New York, December 1949.

17. Steel Founding Productivity Team, "Steel Founding", Anglo-American Council on Productivity, London, September 1950.

18. Simplification Team, "Simplification in Industry", Anglo-American Council on Productivity, London and New York, October 1949.

19. Simplification Team, "Simplification in British Industry", Anglo-American Council on Productivity, London and New York, August 1950.

TAB

PRODUCTIVITY IN EUROPE

Economic Commission For Europe

(Economic Survey of Europe In 1949)

Geneva 1950

The Economic Commission for Europe of the United Nations reported in its economic survey of Europe in 1949 that the large increases in production achieved during 1949 were chiefly due to an increase in output per head. Indices of the level of output per man in industry (based on national production and employment indices in manufacturing industries, mining, gas, water, and electricity supply) were complied by the commission.

The increase in productivity from 1948 to 1949 was exceptionally large in Austria and Germany although the level reached was still below pre-war levels. The figures for Czechoslovakia, Ireland, and the Scandinavian countries (other than Finland) indicated an increase of output per head of only 2 to 3 per cent over 1948, but those for all other countries surveyed (Belgium, Finland, France, Italy, Netherlands, Poland, and the United Kingdom) indicated an increase of between 5 and 9 per cent. Belgium, Western Germany, and Italy were the only countries in which the rate of increase was higher than in 1948. The pre-war levels of productivity were exceeded in 1949 by Czechoslovakia, Finland, France, Ireland, Poland, Sweden, and the United Kingdom. The commission cautioned that it should be remembered that the working hours had changed by comparison with pre-war practice in some countries, so the figures of output per man employed in compiling the indices did not necessarily indicate the changes that have taken place in output per man hour.

The commission reported that the large increases in European productivity immediately following the end of the war were mainly the result of

of the gradual elimination of shortages of certain raw materials and power and economic recovery in general; but the increases in productivity from 1948 to 1949 appeared to have been chiefly the result of technical improvements. High but declining rates of productivity are predicted to continue until the interruption of technical progress in industry during the war is made good. The commission estimated that the lack of any substantial reserves of manpower in Western Europe made increased output primarily dependent upon increased productivity. Industrial production is expected to increase from 5 to 8 per cent between 1949/50 and 1950/51. In Eastern Europe a larger increase in most countries is expected--mostly in the order of one-fifth--due to the greater possibilities of transferring manpower to industry and to the higher rates of increased productivity which could be expected at the relatively low levels of production prevailing at the present time.

Several factors believed to influence long-run trends in labor productivity were listed in the survey. These were:

1. Changes in technology
2. Growing technical skill of workers
3. Improved knowledge of organization
4. The tendency in a progressive economy for the unit cost of capital equipment to fall in relation to the unit cost of labor. This could result in a change of production methods in a more labor-saving and capital-intensive direction.
5. The limitation of profits by the availability of labor. This

could provide increased incentive to introduce labor-saving machinery.

6. Changes in the level of investment (replacement of old equipment, an extension of capacity, transition to heavier industries, or an increase in capital per worker). The effect of a given investment on productivity was thought to be closely dependent upon the time lag in the application of modern techniques of the production methods corresponding to the latest shift in the relative costs of labor and capital equipment.

7. The restricting influence of vested interests in the old capital structure. It is believed that modern techniques are more quickly are more quickly accepted in an expanding economy than in a "stagnating" one.

The commission stated that the measures of productivity were imperfect and that the availability of pertinent statistics did not allow a complete survey to be made of European trends in productivity. It was felt, however, that the available information could indicate prevailing tendencies. The trends in various countries were discussed.

Germany. In the period of "rapid expansion" from 1870 to 1907, industrial output per man was reported to have doubled--estimates placed the annual rate of increase at 2.2 per cent on the average, but in the latter part of the period the rate rose to 2.4 per cent. From 1907 to 1929 the annual rise in output per man was estimated to be probably less than 0.5 per cent due mainly to a "stagnation" in productivity caused by the

war. If the shortening of the working week in this period were taken into account, it was calculated that the rate of increase per man hour reached about 1.2 per cent per year. In the 1930's the rate of increase in productivity per year was judged to be between 1.0 and 1.5 per cent.

United Kingdom. In the period of slow development from 1907 to 1924, the annual increase in output per man was calculated to be about 0.5 per cent and in output per man hour, about 1.5 per cent. In the latter years of this period, the commission estimated that it rose by about 2.4 per cent per year. The survey indicated that the revival of industrial activity in the 1930's was accompanied by a more rapid rise in productivity.

Sweden. The productivity trends in Sweden were tabulated as follows:

Increase in Output and Output Per Man in Manufacturing - Annual rates of increase in percentages

	Output	Output Per Man	Output Per Man Hour
1896-1913	4.5	1.6	2.0
1920-1929	5.3	3.5	3.2
1929-1939	5.2	3.2	3.0

In its survey of Sweden, the Economic Commission concluded that the rate of increase in productivity at the end of the last century and until 1913 was maintained during the inter-war period. The rapid rise in productivity at the beginning of the 1920's was believed to be an effect of the "stagnation" during World War I. From the middle of the 1920's to World War II, the rise in output per man was calculated to be fairly stable at 3.2 per cent per year.

Other Countries. In the period from the middle 20's to World War II, the increase in productivity was reported to be almost as great in Finland

as in Sweden. A rapid expansion in industrial output was also reported for the Netherlands between 1908 and 1929 when estimates placed the annual increase in output per man at 2.3 per cent and in output per man hour at 3.4 per cent. The commission stated that in some countries where production stagnated in the 1930's productivity rose very little and even declined. In France, Italy, and Poland output per man in 1937 was estimated to be below the 1929 level, while the increase in output per man-hour was reported to be only slightly higher. Similar tendences were found to prevail in Belgium and Czechoslovakia.

THE LEVEL OF OUTPUT PER MAN IN INDUSTRY
Index numbers based on 1935-1938, 1947 and 1948

Country	1935-1938 = 100			1947 = 100	1948 = 100
	1947	1948	1949	1948	1949
Austria (a)	47	65	76	138	116
Belgium (a)	81	85	93	105	109
Czechoslovakia (a)	89	100	102	112	102
Denmark	90	95	97	105	102
Finland	93	102	107	110	105
France	84	95	102	113	108
Germany - West. zone	39	52	72	137	138
Ireland	102	111	113	109	102
Italy	88	92	98	105	106
Netherlands	72	77	81	107	105
Norway	88	91	94	103	103
Poland (b)	87	99	105	114	106
Sweden	110	116	118	105	102
United Kingdom	106	113	118	107	105
Total of Countries Listed:					
Including Germany (c)	79	88	96	111	109
Excluding Germany	93	100	105	108	105

NOTE: The index numbers for each country are the ratio of the index of industrial production and the index of employment in manufacturing industries, mining and gas, water and electricity supply. For those countries in which there have been territorial changes, productivity in the post-war territory has been related to 1938 productivity in the pre-war area. The totals for all countries listed, however, have been adjusted to constant (post-war) territories for all years.

(a) 1937 = 100. The base of the index of production for Belgium is 1936.
(b) 1938 = 100
(c) Western zones only.

ECONOMIC BULLETIN FOR EUROPE

AVERAGE OUTPUT PER MAN-YEAR IN INDUSTRY - Average 1935-38 = 100

Country	1935	1936	1937	1938	1946	1947	1948	First Quarter 1949
Belgium (a)	-	-	-	-	97	92	96	105
Czechoslovakia (b)	-	-	100	-	-	89	98	99
Denmark (c)	100	100	100	100	84	92	98	-
Finland	97	102	102	99	92	97	107	111
France	97	105	106	93	76	84	94	105
Germany (d)	95	99	101	103	39	41	62 (e)	71
Hungary	105	102	100	95	51	82	109	110
Italy	94	100	106	99	-	73	80	-
Netherlands	95	102	104	99	70	77	82	86
Norway	99	100	101	101	-	-	87	92
Sweden	96	99	103	102	114	115	117	-
United Kingdom	93	102	107	99	104	107	115	122
United States	96	105	105	94	120	125	127	130

(a) Average 1936-1938 = 100
(b) 1937 = 100
(c) Output per man-hour
(d) For the post-war years, Western zones only.
(e) Second half of 1948

Source: Economic Bulletin For Europe, United Nations, Economic Commission For Europe, Volume 1, Number 2, Second Quarter, 1949.

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In the discussion of "relative changes of labour costs in industry," the Economic Bulletin For Europe (United Nations, Economic Commission For Europe, Second Quarter, 1949) included an analysis of output per man-year in industry. The report stated:

"....an attempt is made to estimate the relative changes in labour costs in industry in a number of European countries and in the United States between the pre-war period and the first quarter of 1949. No account is taken of the changes in exchange rates which have subsequently been made. The estimates refer to industry as a whole--i.e. they include mining, manufacturing, and electric power production. Whenever possible, the average of four pre-war years, 1935-1938, has been used as a basis of calculation since, for some countries, the figures showed considerable fluctuation from year to year. The calculations aim at estimating the relative changes in labour costs per unit of output through a comparision of the relative movements of output per man-year and for annual earnings of manual workers, adjusted for employers' contributions to social insurance and other social security schemes.....Estimates of average output per man-year in industry....are obtained through a comparison of the index of production and the index of employment.....Each of the statistical series employed is subject to a certain margin of error probably being greatest in the series for production and wages and smallest in the series for employment. Since the percentage margin of error in the final estimates is

"the sum of the percentage of errors in the component series, the margin of error in the final estimate must be considerable and might be of the order of 15 to 20 per cent.....As compared with the estimates presented in Table 68 of the /Economic/ Survey /of Europe in 1948/ the significant differences are due mainly to the fact that output per man in the United States was particularly low in 1938 /as shown in the Bulletin's table/, and that the number of hours worked per man rose by 13 per cent between 1938 and 1948 in the United States; whereas in the European countries they appear to have remained almost unchanged (with the exception of France, where there has been a substantial rise). On a man-hour basis, the present estimates show that the increase in productivity in at least two of the European countries--Sweden and the United Kingdom--was comparable with that in the United States. The increase in output per man-hour in the United States between 1935-1938 and 1948 was 16 per cent; whereas the comparable figures for both Sweden and the United Kingdom may be put at 18 per cent."

REGIONAL DIFFERENCES IN PRODUCTIVITY IN EUROPEAN AGRICULTURE

Arnold Daniel

(From the Review of Economic Studies
Volume XII, 1944-45, pp. 50-70)

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Arnold Daniel in "Regional Differences of Productivity In European Agriculture" illustrated the differences in productivity per unit of area in the following table showing the yields of the same principal crops in different countries: (The unit of measurement is metric tons per hectare.)

I. Celtic Region (1)

	Great Britain	Ireland	Nether-Lands	Belgium	Switzer-land	France
Wheat	2.26	2.52	2.97	2.63	2.13	1.54
Maize	-	-	-	-	2.92	1.47
Potatoes	17.0	18.4	18.7 26.1 (2)	21.1	15.3	10.7

II. Teutonic Region

	Germany	Austria	Denmark	Sweden	Norway
Wheat	2.21	1.61	2.99	2.28	1.83
Maize	2.95 (3)	2.26	-	-	-
Potatoes	16.0	13.5	16.8	13.7	18.1

III. Western Slav Region

IV. Eastern Slav Region

	Czecho-Slovakia	Poland	Hungary	Soviet Russia 1909/13	Soviet Russia 1928/32	Soviet Russia 1933/37
Wheat	1.74	1.18	1.39	0.66	0.67	0.88
Maize	1.83	1.06	1.74	1.13	0.88	1.04 (4)
Potatoes	13.0	11.6	6.7	7.0	7.8	8.8 (4)

V. East Baltic Region

	Finland	Estonia	Latvia	Lithuania
Wheat	1.71	1.11	1.28	1.22
Maize	-	-	-	-
Potatoes	13.7	12.3	12.0	11.6

VI. Southern Slav Region

	Yugo-slavia	Bulgaria	Rumania
Wheat	1.15	1.20	0.96
Maize	1.61	1.17	1.05
Potatoes	5.9	5.3	9.1

VII. Mediterranean Region

	Portugal (5)	Spain (6)	Italy	Greece	Turkey
Wheat	0.82	0.91	1.42	0.78	0.89
Maize	0.91	1.59	1.84	0.87	1.28
Potatoes	18.6	11.4	6.0	5.6	2.9

(1) The figures for the yields of wheat, maize, and potatoes in the different agricultural regions of Europe are calculated on the base of the International Yearbook of Agricultural Statistics, Average 1928-38. Metric ton is equal to 0.984 ton. One hectare equals 2.47 acres.
(2) Potatoes for fodder and industry
(3) 1937, 1938
(4) 1933-35
(5) 1928-37
(6) 1928-36, wheat 1928-35

Daniel admitted that this method of comparison might be misleading as a more reliable measure of agricultural productivity required the summing up of all the different kinds of plant products of farms. This was done on the basis of their feeding value (starch equivalent) which served as the common denominator[1].

Gross Plant Production On Arable Land and On Permanent Meadows (Yearly average of the Period 1928-37 for Germany and 1934-37 For the Other Countries)

Arable Land	Germany	United Kingdom	France	Poland	Hungary	Rumania
Area 1,000 Hectares	20,174	5,254	21,174	18,557	5,608	13,276
Production 1,000 tons of Starch Equivalent	36,224	8,590	27,080	21,105	7,383	12,438
Kilogrammes of starch equivalent per hectare	1,796	1,636	1,280	1,137	1,316	937

Gross Plant Production On Arable Land and On Permanent Meadows (Yearly Average of the Period 1928-37 for Germany and 1934-37 For the Other Countries)

Meadows	Germany	United Kingdom	France	Poland	Hungary	Rumania
Area 1,000 Hectares	5,543	2,063	5,579	3,799	646	1,405
Production 1,000 tons of Starch Equivalent	6,597	1,470	5,013	2,196	410	729
Kilogrammes of starch equivalent per hectare	1,190	714	899	578	632	518
Arable & Meadows						
Area 1,000 hectares	25,717	7,317	26,753	22,354	6,254	14,681
Production 1,000 tons of starch equivalent	42,821	10,060	32,093	23,301	7,793	13,167
Kilogrammes of starch equivalent per hectare	1,665	1,375	1,200	1,042	1,246	897

Daniel stated that the inferiority of Great Britain per unit of area as shown in the last line of the above table was due to the comparatively high wages and low farm prices. He added that efforts werebeing made at that time (1944-45) in Britain to increase the gross yields. It was observed that the "quantitative plant production" in Hungary per hectare was about on the same level as in France. This observation was noted by the author in view of the fact that Hungary had been substantially behind France in the past. Depopulation of French villages, particularly in the South, and progress in Hungary were given as explanations of the change. Daniel concluded from the above table that "in the productivity of agriculture per unit of area there is less difference between eastern countries like Rumania and Poland on the one hand, and western countries onthe other, than is generally supposed." The reason given for this was that in the Eastern countries, which have a peasant overpopulation, the farming is organized in such a way as to maximize the

the plant output per unit of area, even if it meant a low output per unit of work. In the greater part of Eastern and Southern Europe, the plant production per unit of area was reported to be about as low as in Rumania. On the whole, the yields in regard to animal production were found to be in proportion to the efficiency in plant production.

The differences of productivity in European farming were attributed to several reasons. Variations in natural conditions (geographical, temperature, rainfall, etc.) were presented as a factor affecting productivity. To diminish the effect of these variations efficient weapons could be developed, but Daniel's analysis indicated that there were limitations other than natural conditions.

He stated that even in countries with the most undemocratic distribution of land, 60 to 70 per cent of the total cultivated area was taken up by small and middle-sized farms having few draught animals. This meant that the land was often plowed shallowly, and modern arable farming was felt to be based on deep culture. In the regions where the importance of deep plowing was thought to be the greatest (Western and Souther Slav, East Baltic, and the greater part of the Mediterranean region), the bulk of the peasantry was less able to carry it out. Cooperative Associations and farm regrouping were discussed as aids to overcome the disadvantages of peasant farming.

Daniel calculated in the following table the capital investment in the farms of the various regions and discovered that there were considerable differences.

Capital Investment In Buildings and Working Capital (i.e. Livestock, Implements, Circulating Capital) on the farms, per hectare in gold dollars (1)

	$
Switzerland, 1927-30	
Grazing farms with a few fields	885
Farms with improved three-year rotation	758
Denmark, 1927-30	
Farms with an area of less than 10 hectares	582
Farms of 10-20 hectares	378
Poland, 1927-30	
West	207
East	73
Estonia, 1927-20	75
Hungary, 1932-33	
Farms with an area of 1-100yokes (1-142 acres)	126
Estates with an area of more than 1,000 yokes (more than 1,422 acres)	72
Rumania	
Danubian Plain, 1934-35	99
Moldavia and Bessarabia, 1933-35	52

(1) This information was calculated on the basis of data contained in Documentation for the European Conference on Rural Life, 1939, published by the International Institute of Agriculture, Rome, 1939.

(Daniel warned that these figures should be interpreted with caution, but added that they were sufficient to show the "very great difference in capital equipment of farming between Eastern and North-Western Europe.")

The high capital investment of the Swiss and Danish peasant farms was attributed to their high plant output which enabled them to accumulate capital from their own savings. The low output of the farms in Eastern and Southern Europe caused by the low degree of fertility was determined to have kept the peasants in this area in poverty. Their poverty was reflected in the low capital investment and in the low level of education of the masses. Education

was considered to be an important factor in the extension of improved agricultural production and techniques.

A proposal for improving the agriculture of the poorer areas through changing the composition of production was discussed. A group of experts[2] had suggested that the production of protective foods (meat, dairy products, eggs, fruits, and vegetables) should be extended in all European countries (except Russia) while less cereals should be grown and more imported from overseas. In this way they felt that there would be more value per acre even if the yield were low. Daniel believed this proposal was limited by the lack of an adequate internal market for protective foods in many countries due to low levels of income; by the high price of protective foods in relation to their capacity to satisfy hunger; by the limited export market; by the high capital requirements of animal production; and by the difficulty of fodder production in some areas due to summer droughts.

Daniel mentioned two ways to increase yields where the degree of fertility was low or medium--irrigation and drainage, processes which require much capital and new methods of agricultural techniques (terracing of inclines, mechanization, etc.) which require far less capital per acre.

"Collectivisation" as a method to utilize completely machinery on peasant farms was evaluated by Daniel with respect to Russian achievements. He calculated that the net increase of total plant output, 1928-1938 in terms of starch equivalents, was only slight (a substantial decrease in livestock resulted in a decrease of fodder produced), but that fuller use of tractors would imply a substantial increase in the crop yields per acre and in the

areas sown. Daniel stated that a "sound development of Soviet agriculture presupposes, in sum, a large increase in live stock" to provide the needed fertilizer. He observed that "the experiment [collectivization in Russia] suggests that compulsory collectivisation in backward peasant areas results in a complicated and rigid bureaucratic system, which is hardly suitable for a really systematic raising of agriculture to a higher degree of productivity."

Supplying the peasants with a lighter type of mechanical power to cultivate the small farms deeply and economically so as to combine the self interests of the individual farmer with deep soil culture was presented as a solution to difficulties of collectivization.

Daniel concluded that particular progress should be possible as a result of technical improvements in the Western Slav region, Southern France, and Middle Italy where the degree of fertitity is not too low. Substantial improve- is thought possible in other Eastern and Southern European areas where natural conditions are less favorable. He believed that the highest output per acre could be achieved in what he called the "Celtic" and "Teutonic" regions. The introduction of "modern systematic agriculture" all over Europe would result, in Daniel's estimation, in lessening the degree of regional differences in productivity.

(1) "The feeding value of 100 lbs. of wheat can be expressed as 71.3 lbs. of starch equivalent, of 100 lbs. of fodder beets as 6.3 lbs., of 100 lbs. of hay as 28 lbs. and so on. Thus 100 lbs. of each of these products (a weight of 300 lbs. in all) amounts to a feeding value of 71.3 + 6.3 + 28.0, i.e. of 105.6 lbs. of starch equivalent. (c.f. O. Kellner, Die Ernaehreing der landwirtschaftlichen Nutztiere, Berlin 1919) The writer has used this statistical method since 1924 in different publications, e.g. in the Berlin Periodical, Der Deutsche Volkswirt, 14th October 1932. Since 1937 the Statistisches Reichsamt of Germany has also adopted this method. See Anbau und Erntestatistik des Deutschen Reiches, Vol. 515, 1937, Page 5, and the subsequent yearly sets of the German Official Periodical, Wirtschaft und Statistik."

(2) Experts - as e.g. in the Conference on Post-war Agriculture, March 1942, arranged by the British Association for the Advancement of Science. See the report of the British Association published in 1942.

TAB

PRODUCTIVITY IN JAPAN

Both the report of the 1949 Economic Survey of Asia and the Far East published by the United Nations and the report of the 1950 Asian regional conference of the International Labour Organization found that "comprehensive and accurate data relating to productivity of labour are not available for any of the countries of Asia and the Far East." It was suggested, on the basis of the limited information available, that the recovery of productivity in this area has been slower than in Europe. This slower recovery was felt to be due to a lower ratio of capital intensity and the shortage of skilled workers. It was pointed out that the limited capital equipment of the region had to sustain the strain of war for a longer period than in Europe and that it has been harder for Asian countries to obtain new capital equipment and spare parts. Civil disturbances in a number of Asian countries were felt to have added to the loss and depreciation of equipment.

In discussing productivity in coal mines in Japan, the Conference report stated that output per month per worker had declined from 17.1 metric tons in 1934-1938 to 6.1 metric tons in 1948, although there was a steady trend upward in 1949--the output for March 1949 being as high as 7.9 metric tons. The chief reasons given for this decline were the employment of inexperienced labor, depreciated capital equipment, shortages of replacement equipment, and the working of inferior seams.

A comparison of the war-time coal production in terms of output per man per year for Japan, Great Britain and the United States was made by Jerome B. Cohen in "Japan's Economy in War and Reconstruction."

Coal Production

Employees (in thousands)	1941	1942	1943	1944
Japan - total	339	375	393	416
Japanese workers	279	273	265	266
Koreans and others	60	102	128	150
Great Britain	698	709	708	710
United States	457	462	416	393
Annual Production (in million metric tons)				
Japan	55.6	54.2	55.5	49.3
Great Britain	209.6	206.9	197.6	191.0
United States	466.4	528.7	535.5	562.1
Output per employee per year (metric tons)				
Japan	164	144	141	119
Great Britain	300	292	279	269
United States	1,021	1,144	1,287	1,430

Sources: Japan Coal Control Association, Tokyo, 1945; Great Britain Statistical Digest, Ministry of Fuel and Power, London, 1945; U.S. Bituminous Coal in 1944 Including Lignite, U.S. Bureau of Mines, Washington, 1945.

Cohen, on the basis of this table, points out that while U.S. per capita output of coal rose significantly during the war period, Japan's and Great Britain's declined markedly, the former by 28 percent and the latter by 11 percent. By 1944 Japanese per capita output was less than one-half of the British and only one-twelfth that of the U.S. He mentioned deterioration of equipment, lack of repairs, and the lack of special tools and simplified operations for the new and inexperienced workers as some of the reasons for the low productivity of Japan. Cohen

found that there was progressive weakening of the labor force during the war and that while the total workers in the iron and steel industry had more than doubled, output declined. In comparing German and Japanese steel industries during the war, Cohen determined that the per capita output of the German steel industry in 1941 was 81 tons of ingot steel per worker and the comparable Japanese figure was 54 tons per worker. By 1944 he found that the German output per worker had dropped to 56 tons, or two-thirds of the 1941 figure, while Japanese was down to 21 tons, or two-fifths of the 1941 figure.

Cohen also compared manufacturing efficiency in the aircraft industry of Japan and Germany to the United States and arrived at the following indices on an output weighted per pound-per employee-per day basis:

Year (July)	U.S.	Japanese	% to U.S.	Germany	% to U.S.
1941	1.42	0.63	44	1.15	81
1942	1.88	0.63	34	1.30	69
1943	1.88	0.71	38	1.50	80
1944	2.76	0.71	26	1.25	45
1945	2.36	0.42	18	...	..

Cohen found the picture to be the same everywhere in industry--declining per capita output over the war years and very low production per worker when compared with industries abroad. In the oil industry, output per man per day declined from 8.18 barrels in 1940 to 3.25 barrels in 1943. The number of persons engaged in crude oil production in Japan proper was estimated to have more than doubled between 1942 and 1944, but production was estimated to have decreased by 10 percent. In the chemical industry during this time, Japan needed 1,012 man-hours to produce a ton

of single-base smokeless powder and the U.S. needed 5.5 man-hours. For a ton of TNT, Japan required 272 man-hours, the U.S. 10 man-hours. Japan required 1,178 man-hours per ton of tetryl and 1,025 per ton of hexogen, while the U.S. figures were 67 and 20 man-hours per ton respectively. Traditionally low wages and no incentive to improve the efficiency of labor by such accepted methods of improved lighting and safety devices were thought to contribute to Japan's low productivity.

In a general discussion of the development of Japanese industry, G. C. Allen (Japanese Industry: Its Recent Development and Present Condition, 1939) emphasized the special problems to be considered and concluded that in a country, such as Japan, where capital is relatively scarce and dear and industrial labor is relatively plentiful and cheap, the entrepreneur finds it profitable to minimize investment in fixed capital goods; and where technical conditions permit, to choose processes which require a high production of labor. The entrepreneur also tries to reduce risks of capital lossed by having operations performed outside the plant. The disadvantages of such a system were found to be compensated for by the low costs and small risks involved. Mr. Allen noted that Japanese economists emphasize the importance of the cheapness and the accessibility of electric power as a factor in preserving the small unit in their country and stated that the division of the manufacturing processes among large numbers of small specialist producers can be effected without serious loss of efficiency.

In some industries, as cotton, the tendency is believed to have been towards enlargement of the scale of plant accompanied by a "remarkable increase in efficiency as measured by output per worker."

Mechanization, better layouts, temperature and humidity control, standardization, specialization, better training facilities are listed as aids to increased efficiency in industry as a whole. Allen stated that the "disparity between her [Japan's] efficiency and her rivals diminished greatly in recent years."

It is admitted that Japan's large-scale industries are still smaller than the corresponding ones in Western countries, but Allen concluded that from the low level of attainment ten years previously (1929), Japan had made an "astonishingly rapid advance."

In the estimation of Isoshi Asahi in The Economic Strength of Japan, the advance in industrial efficiency between 1930 and 1936 was "most remarkable" in the heavier industries. In the metallurgical trades the output per operative per hour was estimated to have increased from 1.91 yen in 1930 to 2.91 yen in 1936. He prepared the following tables analyzing the productivity trends in this period:

Value of Output Per Hour Per Labour Unit
In Factories with 5 or more Workers

Year	Yen	Indices	Indices of Output Adjusted by Wholesale Prices
1930	1.19	100	100
1931	1.10	92	109
1932	1.24	104	130
1933	1.45	122	123
1934	1.48	124	126
1935	1.54	129	126
1936	1.59	133	122

Source: Factory Statistics

Output per Hour per Operative in Heavy Industry

Metallurgical Industry

Year	Yen	Wholesale Price Indices	At 1930 value Yen	Indices at 1930 value
1930	1.91	100	1.91	100
1931	1.64	83	1.96	102
1932	2.10	101	1.99	104
1933	2.36	130	1.81	94
1934	2.68	128	2.09	109
1935	2.83	122	2.32	121
1936	2.91	129	2.40	125

Chemical Industry

Year	Yen	Wholesale Price Indices	At 1930 value Yen	Indices at 1930 value
1930	2.38	100	2.38	100
1931	2.25	85	2.64	110
1932	2.38	89	2.67	112
1933	2.66	117	2.38	100
1934	2.60	100	2.60	109
1935	2.72	88	3.09	129
1936	2.59	78	3.32	139

In the 1948 report of the U.S. Committee inquiring into the economic problems of Japan and Korea, several obstacles to an increase in Japanese production were listed:

1. Lack of essential raw materials - coking coal, raw cotton, wood pulp, oil, etc.
2. Bad condition of many existing factories - disrepair, need for modernization of plant and equipment.
3. Poor state of transport - lower operating efficiency; dearth of coast-wise shipping.

The Committee reported that even despite the physical limitations, productivity could have been at a high level except for the lack of reasonable assurance of reward and incentives. They commented on the air of uncertainty

which seemed to have an effect on workers, managers, and owners. It was also noted that steady effort was discouraged because the real return for work had ceased to be related to effort and had become subject to chance and sudden change. The output of workers in various branches of industry and mining was found to be lower than before the war due in large part to defective tools, interruptions in the supply of raw materials, and inadequate food, housing, and clothing. The committee felt that output would probably increase when and as these conditions were improved. They recommended that the uncertainty in regard to the reparation issue be finally settled and expressed the opinion that the capacity which could be spared without affecting Japan's useful peacetime productivity was not great.

SOURCES

Allen, G. C., Japanese Industry: Its Recent Development and Present Condition, I.P.R. Inquiry Series, Institute of Pacific Relations, New York, 1939.

Asahi, Isoshi, The Economic Strength of Japan, The Hokuseido Press, Tokyo, 1939.

Cohen, Jerome, Japan's Economy In War and Reconstruction, University of Minnesota Press, Minneapolis, Minnesota, 1949.

Report on the Economic Position and Prospects of Japan and Korea and the Measures Required to Improve Them, Committee to Inquire into the Economic Problems of Japan and Korea(Sent at the Invitation of the U.S. Secretary of the Army.), 1948.

Report of the Director General, Asian Regional Conference, January 1950, International Labour Organization, Geneva, 1950, pp. 21-23.

United Nations, Economic Commission for Asia and the Far East, Economic Survey of Asia and the Far East in 1949, Lake Success, New York, 1950.

Indexes of Workers' Productivity In Manufacturing Industry
In Certain Countries, 1928-1936 (1)
(Base: 1929 = 100)

Year	Japan	France (2)	Germany	Great Britain	United States
1928	90.4	-	98.6	96.4	98.8
1929	100	-	100	100	100
1930	105.3	100	92.2	96.1	92.4
1931	112.1	95.7	82.9	90.8	92.2
1932	119.3	84.7	75.0	91.1	87.9
1933	125.9	96.2	84.2	93.0	97.1
1934	128.7	91.9	93.3	99.5	88.3
1935	129.4	91.3	103.8	104.0	96.4
1936 (3)	128.0	97.0	106.9	110.3	102.4

(1) League of Nations: Monthly Bulletin of Statistics. The index of productivity is obtained by dividing the index of total production by the index of employment.

(2) Base: 1930 = 100

(3) Averages for the period January-May for Japan, and January-June for the other countries.

Source: Yoshio Kamii, "Industrial Recovery In Japan: Its Causes and Social Effects," International Labour Review, Volume XXXV, No. 1, January 1937, Pages 31-52. The author observes that this table shows increase in productivity in manufacturing industry is more marked in Japan than other countries. He states:

> "According to an investigation made by the Nagoya Imperial College of Commerce, during the decade between 1921 and 1931 the annual volume of production increased by 73.4 per cent., the number of workers decreased by 1.8 per cent., and the output per worker per year rose by 76.5 per cent. During the period from 1920 to 1930, according to the Tokyo Association for Liberty of Trading there was an increase of 67.5 per cent in the volume of production in manufacturing industry, as compared with an increase of 8.4 per cent. in the number of workers, which means that the output per worker rose by 54.5 per cent."

PRODUCTIVITY IN COAL MINING (1)

OUTPUT PER MONTH IN METRIC TONS

Year	Per Wage Earner	Per Underground Worker
1930	12.8	17.2
1931	15.1	20.8
1932	16.9	23.5
1933	18.9	25.8
1934	17.8	24.3
1935	18.0	24.5
1936	17.6	23.8
1937	16.9	23.1
1938	15.4	20.9
1939	14.9	20.4
1940	14.8	20.3
1941	13.5	n.a.
1942	13.2	n.a.
1943	12.5	n.a.
1944	10.8	n.a.
1945	4.7	7.9
1946	5.4	9.7
1947	5.6	10.5
1948		
January	6.2	11.9
February	6.0	11.3
March	6.2	11.7
April	5.5	10.5
May	5.5	10.6
June	5.9	11.2
July	5.8	10.8
August	5.4	10.1
September	6.3	11.4
October	6.6	11.8
November	6.5	11.5
December	7.0	12.3

Sources: For 1930 to 1938, Hompo Kogyo No Susei (Trend of Mining Industry In Japan) published by Mining Bureau, Ministry of Commerce and Industry. For the other periods, Japan Coal Association and Board of Coal.

(1) Extracted from Japanese Economic Statistics, General Headquarters, Supreme Commander for Allied Powers, Economic and Scientific Section, Research and Programs Division, Bulletin No. 28, December 1948, p. 13.

Workers' Productivity In The Cotton Industry In Japan, 1925 and 1928-1933 (1)

	Spinning				Weaving			
	Prod.	Workers	Prod. per Worker		Prod.	Workers	Prod. Per Worker	
Year	1,000 Piculs	1,000	Piculs	Index	Million Yards	1,000	1,000 Yards	Index
1925	2,437	174	14.0	100	1,180	56	21.1	100
1928	2,452	154	15.9	114	1,382	44	31.4	149
1929	2,793	160	17.5	125	1,538	43	35.8	170
1930	2,525	139	18.1	129	1,388	35	39.7	188
1931	2,567	122	21.0	150	1.405	29	48.4	229
932	2,810	127	22.1	158	1,533	30	51.1	242
1933	3,100	129	24.0	171	1,674	34	49.2	233

Source: Report of the Japanese Cotton Spinners' Association, quoted in Oriental Economist, Japanese edition, 28 July 1934.

Extracted From: "Industrial Recovery In Japan: Its Causes and Social Effects," Yoshio Kamii, International Labour Review, Volume XXV, Number 1, January 1937, pp. 31-52.

TAB

RUSSIAN LABOR PRODUCTIVITY STATISTICS

Walter Galenson

(From Industrial and Labor Relations Review, Volume 4, Number 1, July 1951)

Approved For Release 2001/08/14 : CIA-RDP79S01046A000100040002-5

Walter Galenson recently published an article on Russian labor productivity statistics in the Industrial Labor Relations Review of Cornell University. Galenson explained the method of calculation used to determine productivity figures, analyzed the difficulties involved in interpreting the data, and presented an evaluation of the statistics. He concluded his article with a discussion of labor productivity in coal mining in Russia.

The author stated that the published Soviet indices of labor productivity expressed "the relationship between gross value of output in constant prices and the average annual number of production workers associated with that output" and that, although physical measures of productivity appeared to be widely employed for "control purposes," the value concept was employed exclusively by the central statistical agencies. The Central Statistical Office, until 1943, was reported to have calculated its index of labor productivity as a "simple relationship of average value of output in constant prices per production worker engaged in industry for current and base periods." Galenson pointed out the deficiency in the "implicit assignment of industry weights on the basis of gross value of output." It was that the productivity indices had an inflationary bias which was reflected in the statistics, for example, as the importance of the fabricating industries (with a relatively high value of output per worker) would increase in relation to the extractive industries (with a relatively low value of output per worker). In 1943 the Central Statistical Office was reported to have changed its methods of calculating its productivity indices.

"The new index," Galenson stated, "is an arithmetic average of the separate indices of individual industries weighted by the number of workers employed in each, eliminating the implicit weighting by gross value of output."

The problems involved in the interpretation of Soviet productivity statistics as listed by Galenson are:

1. Use of constant rather than current prices to measure value of output. The author reasoned that this implied that "an approximation is being made to the measurement of productivity changes in terms of physical output." He pointed out that the possibility of a serious inflationary bias in Soviet indices of value of product had been discussed by others and that to the extent it existed, it was reflected in the productivity indices. He cautioned against interpreting the indices as measuring changes in physical output per worker.

2. Hours actually worked. The author observed that no account is taken of changes in the number of hours actually worked within the period of measurement (a month, quarter, or year) which arose from changes in the length of the working day and in the number of days worker per year.

3. Denominator of the productivity fraction. The author stated that Russian industrial employees are divided into five classifications: workers participating directly in production and engaged in physical labor; apprentices; engineering and technical personnel; administrative, clerical, and statistical personnel; service personnel (guards, porters, etc.). Only the first category was included in productivity measurement.

4. Divergencies between statistics. The author warned that there are likely to be serious differencies between the labor force statistics presented in the two major statistical handbooks for various years--"Socialist Construction" and "Labor in the USSR"--with respect to both concept and coverage.

In evaluating prewar data through a comparison of Russian statements with independent calculations, Galenson found that certain discrepancies were not sufficient "to impugn the internal consistency of the Russian data, or to warrant dismissal of the Russian productivity claims as meaningless," but added that the productivity gains claimed by the Russians for the period 1928 to 1940 were high. The author did not feel that these high claims were "absurd" as the 1928 productivity base was extremely low. In regard to postwar statistics Galenson remarked that wartime and postwar productivity trends in the USSR could not be "linked directly to prewar data because of the absence of a common base."

Galenson stated that the Russians themselves conceded that in 1937 their industry was only 40 percent as productive as American industry and that it was not until 1948 that they exceeded their prewar productivity level. He found, however, that the 40 percent comparison was of "dubious validity" in view of the fact that this was the approximate relationship of British to American industry during the period 1935-1939, and it was judged unlikely that Russian productivity equaled the British for this period.

In the section on coal mining, Galenson concluded that there appeared to have been a positive relationship, in prewar periods, between the rate of growth of output and the rate of increase in labor productivity in Soviet coal mining (the years 1930-32 excepted). The rapid production advances from 1932 to 1938 were assigned to the increased mechanization of face work, but it was asserted that after 1938 only limited progress was made on this account. The limitation of the data did not permit definite conclusions on coal productivity after 1940.

Galenson determined that estimates placed labor productivity in Russian coal mining at 26 percent of the American level for the immediate prewar period (output per man-shift in U.S. bituminous mines was estimated at 4.37 tons and Russian output per man-day was estimated at 1.12 tons). Fragmentary data for the years since 1940 was found to indicate that "coal fields devastated during the war had not recouped their 1940 labor productivity by the end of 1949, but that the decline may have been offset by a shift of output to the relatively more productive fields in the Urals and Asiatic Russia."

In respect to factors affecting productivity, Galenson indicated that there are complaints of the unevenness of mechanization creating bottlenecks; that labor turnover apparently remains a serious problem; and that training facilities are inadequate.

Socialist Construction In the USSR

Central Administration of Economic and Social Statistics of the State Planning Commission of the USSR 1936

General Indices

1. Fixed Capital

2. Industrialization (Share of industrial and agricultural production, changes in structure of large-scale industry, changes in distribution of population, state budget allocations for national economy)

3. Technical Reconstruction (Construction of machinery, power supply and capacity, reconstruction in coal, petroleum, peat, and ferrous metal industries, number of tractors and combines, reconstruction of railway rolling stock)

4. Socialization (Collectivization, state farm development, etc.)

5. Growth of Productive Forces in the USSR (Number of wage earners, salaried employees, annual output per worker, rate of growth of large-scale industry, number of students in schools, output of coal, pig iron and steel)

6. National Income

7. Area and Population

I. Industry

1. Summary Tables (output, capital, depreciation, power supply, organizational structure, distribution)

2. Statistics on individual industries: metal working, electric generating stations, coal, petroleum, peat, ferrous metals, chemical, rubber and asbestos, building materials, timber and woodworking, paper industry, textile, leather-fur-boot and shoe, and food.

Supplementary Tables

1. Output of main products of industry - summary 1913; 1932-35

2. Production of main industries 1928 - 1936

II. Agriculture

1. Gross production
2. Basic means of production
3. Capital investments
4. Machinery and mechanical equipment in agriculture
5. State farms
6. Machine and tractor stations
7. Collective farms
8. Field husbandry

III. Transport and Communications
1. Railway Transport (operating length of RR lines, electrified RR, car loadings, freight, passengers, rolling stock, revenues and expenditures)

2. River transport (freight, passengers, length and equipment of inland waterways)

3. Marine transport (freight, passengers, and tonnage)

4. Air transport (length of airways, civil aviation)

5. Communications (post, telegraph, telephone, radio)

IV. Capital Investments

V. Labor (employment, wage and salary, hours, turnover, absenteeism)

VI. Population and Public Health

VII. Trade and Supply(retail turnover, wholesale enterprises)

VIII. Foreign Trade (exports and imports by commodity groups and countries)

IX. Education, Science, and General Culture
1. General and pre-school education
2. Vocational education: training of technical personnel
3. Politico - cultural institutions
4. Books and publications
5. Research institutions

X. Municipal Services (tramways, bus, water supply, sewer systems, and electric generating stations)

XI. Finances (budget figures; banks, depositers, and deposits; public debt, and credit institutions.)

TAB

METHODS OF LABOUR PRODUCTIVITY STATISTICS

International Labour Organization

International Labour Office

Geneva, 1951

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In the consideration of methods of labor productivity statistics, the International Labour Office discussed the possible approaches to the measurement of labor productivity, the comparability of production indices with labor indices, the factors which affected the productivity of labor, and the problems involved in the measurement of labor and output on a national and international basis.

Some Possible Approaches to the Measurement of Labor Productivity.

1.) A comparison, for the two periods under consideration, of the total volume of labor required "to produce the same complex of goods under the conditions prevailing in each period as regards unit labour requirements." Among the choice of possible complexes of goods:

a.) that representing the production composite of the base period (to which the current situation is compared) - "the unit labour requirements index will measure the ratio of labour that would have been spent in the current period to produce the base period complex of goods to the total labour actually expended in the base period."

b.) that representing the production composite of the current period (which is to be compared to certain base standards) - "the unit labour requirements index will indicate the ratio of the labour actually spent to produce the current complex of goods to the labour that would have been spent in the base period to produce the same complex."

2.) "Another approach is to consider that the variations of the unit labour requirements for a certain production composite should be an average of the individual indices of unit labour requirements. In this case the index of each current unit labour requirement as compared to the base period unit

labour requirement is computed for each product, undertaking, or industry; the results are then grouped in an average, which may be an arithmetic mean or a weighted average; the weights can be chosen to represent the relative importance of each undertaking, product or industry in the total production composite chosen, on the basis of total labour expended, gross or net value of production, or any other factor."

3.) "A third method is to compare the average unit labour requirements needed in the current period in order to produce the current period complex of goods with the average unit labour requirements needed in the base period to produce the base period complex, the averages of each period being computed as ratios of the total labour expended to the total production. This will involve a measure of total production for heterogeneous outputs, and thus will involve the use of weights for the computation of these total productions. The weights used to measure the current and the base period production should be identical."

4.) "Another approach is to relate the variations of the total labour expended in each period to the variation in the total output of each period; or, in other words, to compute the ratio of an index of labour to an index of production."

Difficulties in the Comparison of Production Indices with Labor Indices

1.) Limitations of available data or of possibilities of collecting data.

2.) The scope of possible production and labor indices often differs.

3.) The method of computation of production indices sometimes makes it impossible to use them in computation of productivity data - some have "the implicit assumption" that labor productivity remains unchanged.

4.) In the classification of production and labor data taken from the censuses of manufacturers and in data collected separately, there are "basis differences of allocation (ie., production statistics often include the output of primary products of one industry contributed by workers in other industries)."

5.) When data on production and labor are collected separately, there are often serious differences in the scope of the figures.

6.) "The most important drawback in the computation of productivity indices by the division of production indices by labour indices is the fact that in such a division these approximations or errors are compounded."

The factors believed to influence productivity were divided into three catagories: general, organizational and technical, and human.

General: climate; geographical distribution of raw materials; fiscal and credit policies; general organization of the labor market; proportion of the labor force to the total population; degree of unemployment, of labor shortage, and of labor turnover; technical centers and information concerning new techniques; commercial organization and size of the market; general, scientific and technical research; variations in the composition of output; influence of low efficiency plants and their varying proportion in the total output.

Organization and Technical: Degree of integration; percentage of capacity used; size and stability of production; quality of raw materials; adequate and even flow of materials; sub-division

of operations; balancing of equipment; multiple machine systems; control devices; quality of output; rationalization and standardization of work and material; layout and location of plant; maintenance and engineering services: safety, light, sound, ventilation, air conditioning, telephone, etc: availability, fitness, and accessibility of tools, wear and tear of machines and tools; amount of machinery (or powder) available per worker; proportion of maintenance labor to operating labor; length and distribution of working hours; and selection of personnel.

Human Factors: Labor-management relations; social and psychological conditions of work; wage incentives; adaptibility to and liking for the job; physical fatique; composition (age, sex, skill, and training) of the labor force; organization of the spirit of emulation in production; trade union practices.

The Problems Involved in the Measurement of Labor included the following:

1.) The quality of effort, especially mental effort, is "scarcely ever measurable."

2.) The amount of labor input in a given output, even when measured in time spent, is still not completely determined. There are different kinds of labor ie., operating, auxiliary, embodied, and indirect.

3.) In measuring labor productivity, the choice between man-hours or employment as a measurement of labor will depend upon the end in view - man-hour concept for determing changing volume of output in relation to the time actually worked, the productive

capacity of labor, or the cost of production in labor units; output per man concept when measuring productivity with object of estimating manpower requirements, employment possibilities, and future national incomes.

4.) "One limitation common to all studies of labour productivity is that the labour force is treated as a homogeneous entity. In this respect, it is well to remember that the 'worker' and the 'man-hour' are statistical abstractions - that there is, in fact, no satisfactory measurement of a unit of labour. The 'hour of work' is not a homogeneous concept, since its influence on production as well as its 'effort content' differ widely according to the sex, age, skill, and position in the factory of the person who contributes this hour of work."

5.) The concept of man-hours could be understood, statistically, in many ways: hours actually worked, hours paid, etc., and the collection of data always involves problems, and the data "commonly lack comparability even between plants in the industry."

The Problems Involved in the Measurement of Output Were Found to Be:

1.) Difficulty in choosing the unit of measurement - differences in quality or product specifications.

2.) The choice of criteria in defining a given product is made difficult by the fact that each reported product really represents a number of more or less heterogeneous items or a "range," within which "gradations may be either imperceptible or marked."

3.) The definition of an industry is made difficult because

establishments within a given industry produce products belonging to that industry, and to a certain degree, products belonging to other industries which results in statistical overlapping.

4.) There are problems raised by the different degrees of intergration.

5.) "The measurement of processes appears to offer a means of avoiding many of the difficulties involved in measurements based on products, particularly at the level of the plant."

6.) "The duration of the production process has an important bearing on the measurement of productivity. There is some relation between the duration of the production process and the minimum period for which productivity measures may be computed."

Special Problems In International Measurement of Labor and Production Are Discussed In This Article.

International Measurement of Labor.

1.) In national statistics, the definition of direct and indirect labor vary.

2.) There are wide differences in the "content of man-hours." Conflicting interpretations are given to the various notions of man-hours paid, man-hours actually worked, etc.

3.) There is a much greater difference in the composition of the labor force in sex, age, skill, etc., between various countries than between two periods of comparison in one country or between labor employed in undertakings in the same industry in one country.

International Measurement of Production.

1.) The differences in product specifications are greater than in national comparisons.

2.) The difficulties arising out of the definition of the product or the industry are increased in international comparisons.

3.) The differences in integration are generally sharper between the various countries than between various plants of an industry within a country.

Comparability of Production and Labor Data

1.) In a given country, the proportion of a certain product which is produced outside the industry and the proportion of the main products to the by-products within an industry may not be constant over a long period of time. Such proportions are seldom the same in every country.

2.) The scope of the various national censuses is not identical. There are variations over a period of time in the size of establishments included in the censuses of production or in the computations of production or labor indices.

Special Problems of International Comparison

1.) "When comparing productivity data compiled from censuses of production, special attention should be paid to the consideration of the rate of capacity used, which is influenced, for instance, by general economic conditions. This important point is emphasized by the fact that the years for which censuses of production are taken are seldom the same in the various countries: for this reason a comparison is relevant only if the years chosen in the countries to be compared are reasonably comparable as to the rate of unemployment

and use of equipment in relation to capacity."

2.) "When comparisons of values of net output, per head or per man-hour, are made between countries the choice of the rate of conversion is of fundamental influence and involves great difficulties. It would be necessary to make the conversion at the purchasing parity rate for the products investigated."

PRODUCTIVITY IN COAL MINES

Internation Labour Organization

Geneva

May 1951

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In May 1951 the Coal Mines Committee of the International Labour Organization issued a report, Productivity In Coal Mines, which listed a number of factors found to influence productivity. These were natural conditions, technical conditions, organization and management, and working conditions.

Natural conditions included:

(1). Characteristics of the deposits - depth, thickness and dip of seams; nature of the roof and floor; working and personal risks - fire, flooding, dust, etc; regularity of the seams and the hardness of the coal; working conditions dependent on the deposit - humidity, temperature, dust, and resultant safety and hygiene.

(2). Natural composition of coal - composition of raw coal extracted in terms of proportion of actual coal, middlings, shale, and stones.

(3). Working conditions adopted in relation to the size of the deposits. U.S. example in bituminous fields shows that increased output can be obtained by abandoning certain seams and by not completely stripping those which are being worked.

Technical conditions included:

(1). Methods of Working - room and pillar system; longwall retreating system; longwall advancing system (in order of choice).

(2). Mechanization at the face.

(3). Modernization of the handling of coal.

(4). Surface installations - must be ready to receive increased

production.

(5.) Cooperation between mine operators and contractors - in order to insure complete modernization of all factors involved in coal mining and the proper maintenance of the improvements.

(6.) Problems created by social and economic policies of a country in particular and the world in general.

Organization and Management included:

(1.) Headquarters staff - output will be considerably affected by the kind of organization chosen for this staff and its responsible head.

(2.) Research and exchange of information.

(3.) Study centers - could be of great use in the standardization of equipment.

(4.) Training - need for trained engineers and supervisory staff.

(5.) Sales, mechanical preparation, and consumers departments - should be developed to simplify production and thus increase productivity.

Working conditions included:

(a.) Wages - a high wage policy was thought to be generally conducive to increased productivity; time and motion studies, and the setting up of work standards could stimulate productivity.

(b.) Attitude of Workers - "conscientious and continuous work, aided

by a fair price-rate system and income tax system, contributes considerably to higher output;" working conditions (safe and healthy), industrial relations, and vocational guidance influence the attitudes of workers.

The size, nature, composition, and distribution of the labor force also influence productivity.

The Coal Committee reached the following conclusions:

> "In general, it is true to say that output per man-shift is the product - and not the sum - of an engineering coefficient (mining methods, equipment, and plant in general) multiplied by coefficients of organization and labour (especially the miner's work).
>
> "Consequently, an improvement in any one of these three groups of factors has a proportionate effect on final output per man-shift ..... Whether the coal mining industry is nationalized or not, general government policy has clearly a considerable influence on the growth of productivity ..... the countries of eastern Europe stress the great need for industrial productivity, and the Governments of the U.S.S.R., Poland, Czechoslovakia, etc. have issued clear directives to the coal mining industry ..... In Western Europe, the various governments have begun to cooperate with the United States Government under the auspices of the Economic Cooperation Administration ..... On 5 May 1949, the French Government set up a pro-

ductivity committee under the Industrial Equipment Plan. Later a national productivity board took the place of this provisional committee, under the Decree of 27 June 1950.

Productivity in Coal Mines

Coal Mines Committee - International Labour Organization Fourth Session, Geneva, May 1951, Report III

Statistical tables and graphs included in this report:

1.) Europe: output per man-shift of underground workers 1948, 1949, and first half of 1950. (Poland, Netherlands, United Kingdom, Czechoslovakia, Western Germany, Saar, France, and Belgium.)

2.) Europe: output per man-shift, underground and surface workers 1948, 1949, and first half of 1950 - includes countries mentioned above.

3.) Europe: indices of output per man-shift, underground workers, 1945 to June 1950.

4.) Europe: indices of output per man-shift, underground and surface workers 1945 to June 1950.

5.) India: output in metric tons per man per year, for the whole of its underground mines and opencast workings.

6.) Hard coal production in Europe.

7.) Gross Lignite Production in Europe.

8.) World Hard Coal Production, excluding Europe.

9.) World Gross Lignite Production, excluding Europe.

10.) World Hard Coal & Lignite Production.

11.) Number of mine workers on colliery books in the countries members of the Coal Mines Committee and in the Western Germany.

12.) Output per man per day and per man per year, bituminous coal mines in the United States.

13.) Canadian output per man-shift.

14.) Europe: development of output per man-shift (underground and underground plus surface).

Productivity in Coal Mines (cont'd)

Statistical tables and graphs included in this report: (cont'd)

15.) Indices showing the development of production, the labour force, man-hours per year and output man-shift and per man-hour in the United States.

16.) Indices of labour force, production and output per man shift in the coal mines of the countries members of the Coal Mines Committee and of Western Germany.

REPORT OF THE DIRECTOR GENERAL

INTERNATIONAL LABOUR CONFERENCE

GENEVA, 1950

The 1950 report of the Director General of the International Labour Conference in Geneva contained a section on the productivity of labor. Emphasis was placed on the effect of the quantity, quality, and use of resources on productivity. Human resources were found to affect productivity in the following respect:

> "Up to a point growth in the size of the working population, associated with an enlargement of the market, may favour average productivity per head by making possible economies resulting from specialization and division of labour.....After a point, however, with a given stock of capital, including land, further growth in the size of the labour force will be associated with growing pressure of population on the means of subsistence and will tend to reduce average productivity per head."

It was pointed out, however, that productivity depended upon the quality as well as the size of a country's labor force, and such things as low standards of health, nutrition, education, and technical training could impair the quality of the labor force.

In regard to material resources, the report stated that the "qualitative relationship between supply of labour and supply of capital, including land" was important to productivity. It was observed that productivity might be impaired by shortages of working

capital, materials, and fuels; and the report recommended that productive investment should have "soundly conceived developmental plans."

The use of resources received considerable attention. It was suggested that measures be taken to insure a "high and stable level of employment to eliminate waste of unwanted idleness" and to eliminate cyclical fluctuations in demand. Such a measure was believed to reduce the fear of unemployment which has been a "source and justification of resistance to technical change and restrictions on output." The report added that the effects of full employment on productivity were partly dependent upon the "strengthening of positive incentives to effort and to the most productive allocation of labour between jobs."

It was further suggested that there should be a "technically efficient utilization of resources" realized through efficient management, vocational guidance and training, work simplification, incentive methods of wage payments, industrial health and safety, standardization, spread of technical progress, complete utilization of capacity, and the use of shift systems. "Freer trade resulting in wider markets" was believed to encourage specialization and promote productivity. The report concluded that maximum productivity might require "considerable shifting of resources between different industries or services producing for home consumption," and suggested that the determination of the uses to which new capital is put should be carefully studied in all countries.

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